

CPU

COMPUTER POWER USER



MRMTM
MAD READER MOD

Verktøy Cu

DERICK MAGNUSEN TAKES STEAMPUNK TO NEW HEIGHTS





keep reinventing

**Inject new life
into your PC**



HP SSD S700 Series



High Performance



Durability



Power saving



Silent



Walmart



STAPLES



ASI



MONOPRICE



Canada
Computers



ATD Computers
one click, all solutions.

HDSTOR



Mod Project: Etching Tempered Glass



Mad Reader Mod: Verktoy Cu

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BUYER'S GUIDE — P. 55

If eyes are the windows to the soul, graphics cards are the key to the soul. Or something.

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ASRock X299E-ITX/AC For Small PCs

ASRock says its X299E-ITX/AC is the world's first motherboard to feature the X299 chipset in a Mini-ITX format. The LGA2066 motherboard supports the latest X-series processors from Intel, but only those with six or more cores. The board has four DIMM slots and supports up to 64GB of quad-channel DDR4 to 4000+ (OC). There is one PCIe 3.0 x16 slot and three Ultra M.2 slots (PCIe Gen3 x 4), one of which also supports SATA3 6Gbps modules. The board also manages to fit in 6 x SATA3 ports and a front USB 3.1 Gen1 header. The rear I/O includes dual Gigabit LAN connections and the motherboard supports teaming. It also comes with dual band (2.4/5GHz) 2T2R 802.11ac WiFi and support for Bluetooth v4.2. As an added bonus, the X299E-ITX/AC includes an ASRock RGB LED header so you can deck out your system with lighting. A special liquid-cooling block developed by Bitspower that completely covers the CPU and MOSFET areas on the board is available as an optional upgrade. The ASRock X299E-ITX/AC carries an MSRP of \$399.99.

EKWB Slims Down With New 140mm/280mm CoolStream Rads

EK Water Blocks has two new slim radiators available for users building liquid-cooled systems in cases that are tight on space. The new rads are 140mm and 280mm models that fall under the company's CoolStream brand. The EK-CoolStream SE 140 and EK-CoolStream SE 280 both measure just 28mm (1.1 inches) thick. They're also exactly 140mm wide, so you won't have any overhang when using 140mm cooling fans. EKWB says they are compatible with any standard 140 x 140 x 25mm fan. The radiators are matte black aluminum and steel over 90% copper tubing. They have 22 cooling fins per inch. The port threads for tubing are the standard G1/4". Both slim CoolStream SE models are now available for purchase at EK Water Blocks' online store. The EK-CoolStream SE 140 is priced at \$49.99, while the EK-CoolStream SE 280 runs \$69.99.



WATCHING THE CHIPS FALL

Here is the pricing information for various AMD and Intel CPUs.

CPU	Released	Original Price	Last Month's Price	Online Retail Price*
AMD Ryzen Threadripper 1950X (Zen)	8/10/2017	\$999.99	\$999.99	\$999.99
AMD Ryzen Threadripper 1920X (Zen)	8/10/2017	\$799.99	\$799.99	\$779.99
AMD Ryzen 7 1800X (Zen)	3/2/2017	\$499	\$449.99	\$439.99
AMD Ryzen 7 1700X (Zen)	3/2/2017	\$399	\$359.99	\$299.99
AMD Ryzen 7 1700 (Zen)	3/2/2017	\$329	\$299.99	\$299.99
AMD Ryzen 5 1600X (Zen)	4/11/2017	\$249	\$239.99	\$239.99
AMD Ryzen 5 1600 (Zen)	4/11/2017	\$219.99	\$214.99	\$214.99
AMD Ryzen 5 1500X (Zen)	4/11/2017	\$189	\$179.99	\$169.99
AMD Ryzen 5 1400 (Zen)	4/11/2017	\$169	\$164.99	\$149.99
AMD A10-7890K (Godavari)	3/1/2016	\$164.99	\$149.99	\$140.50
Intel Core i9-7980XE (Skylake-X)	9/25/2017	\$1,999	\$1,999	\$2,099.99
Intel Core i7-6950X (Broadwell-E)	5/31/2016	\$1,723**	\$1,577.89	\$1,577.89
Intel Core i7-7940X (Skylake-X)	9/25/2017	\$1,399**	\$1,399	\$1,469.99
Intel Core i9-7900X (Skylake-X)	6/26/2017	\$999.99**	\$969.99	\$969.99
Intel Core i7-7820X (Skylake-X)	6/26/2017	\$599.99**	\$599.99	\$599.99
Intel Core i7-7800X (Skylake-X)	6/26/2017	\$389.99**	\$379.99	\$379.99
Intel Core i7-8700K (Coffee Lake)	10/5/2017	\$359**	n/a	\$389.99
Intel Core i7-7700K (Kaby Lake)	1/3/2017	\$350**	\$309.99	\$339.99
Intel Core i5-8600K (Coffee Lake)	10/5/2017	\$257**	n/a	\$279.99
Intel Core i3-8350K (Coffee Lake)	10/5/2017	\$168**	n/a	\$179.99

* As of October 2017

** Manufacturer's estimated price per 1,000



Patriot Goes To The Dark Side With The Viper V570 Blackout Edition

Patriot Memory announced a new version of its Viper V570 RGB gaming mouse. The new Blackout Edition comes with a dedicated sniper button and ceramic foot pads, and is specially designed for use in FPS and MMO games. The new mouse has Omron switches rated for 10 million clicks and an Avago ADNS-9800 optical sensor that is sensitive up to 12,000dpi. Users can set up to four dpi sensitivity levels and change settings on the fly. Settings for different games can be saved in personal profiles that include custom adjustments for the RGB lighting. The Blackout Edition includes seven independent lighting zones and 13 customizable buttons. You can even adjust the weight of the mouse up or down via removable weights. The Viper V570 RGB Blackout Edition works with Patriot's Viper customization software. Patriot backs the mouse with a two-year warranty. MSRP for the new gaming mouse is \$69.99.

Corsair Adds LL Series RGB Fans

Corsair has added a new series of RGB fans to its cooling lineup. The LL Series RGB fans feature 16 LEDs in every fan, with a dozen LEDs in the outer loop of the fan and four LEDs in the inner loop near the hub. The new fans come in two sizes: 120mm x 25mm and 140mm x 25mm. Fan speeds are controlled via PWM (pulse width modulation) and range from 600 to 1,500rpm on the 120mm units and 600 to 1,300rpm on the 140mm units. Corsair says the lighting for all fans in the LL Series can be customized using Corsair LINK software. The LL Series RGB fans can be purchased individually at retail stores or in packs of three (for 120mm fans) or two (for 140mm fans). The kits come with Corsair Lighting Node PRO, a controller pack that includes cables for connecting up to a dozen fans or eight lighting strips. Pricing is as follows: Single 120mm for \$34.99; 3-Pack 120mm for \$119.99; Single 140mm for \$39.99; 2-Pack 140mm for \$99.99.



SUPERO Adds Z370 Model To Lineup

SUPERO Core Gaming announced it is adding the Z370 chipset to its lineup of gaming motherboards. The new SUPERO C7Z370-CG-L brings a gold-plated LGA 1151 socket with support for Intel's 8th Generation Core processors to the Z370 platform. The ATX motherboard also has four gold-plated DIMM slots that can handle up to 64GB of DDR4 2666MHz (up to 2800+ with Intel's Extreme Memory Profile). There are 2x M.2 connectors (PCIe 3.0 x4, 2260/2280/22110) and six more PCIe slots (2 x PCIe 3.0 x16, 1 x PCIe 3.0 x4, and 3 x PCIe 3.0 x1). The C7Z370-GC-L has 6 x SATA3 (6Gbps) ports. The rear I/O includes 4 x USB 3.0 and 2 x USB 3.0 ports, plus one each USB 3.1 Type A port and Type C port. There also are ports for 7.1 audio the board cranks out thanks to a Realtek ALC1220 audio processor. SUPERO's parent, Supermicro, is well known for producing reliable, long-lasting server boards; the company uses similarly durable components to build its gaming motherboards, and then subjects them to the same strenuous testing regimens.



Show Off Your Hardware In Cooler Master's MasterCase H500P

The MasterCase H500P is a mid-tower with a large glass side panel and seethrough plastic panels on the top and front. The case comes with two pre-installed 200mm RGB fans, plus there are mounts for two additional fans the same size at the top of the case. Users building a liquid-cooled system will find room for 360mm radiators in front or at the top. A removable panel covers cables in the back, and another panel covers the back of the CPU cutout. There's also a full shroud for the PSU. The chassis measures 21.3 x 9.5 x 21.4 inches (HxWxD). There are two 2.5- or 3.5-inch drive bays, plus two more bays for 2.5-inch SSDs. The case supports graphics cards up to 16.2 inches long and CPU coolers up to 7.5 inches tall. Two PCI slots in back allow you to vertically mount a graphics card to show it off through the glass side panel. (You will need to purchase optional riser cables, and Cooler Master sells a vertical GPU support bracket, as well.) The MasterCase H500P comes in either gunmetal or black and carries an MSRP of \$149.99.

HARDWARE MOLE



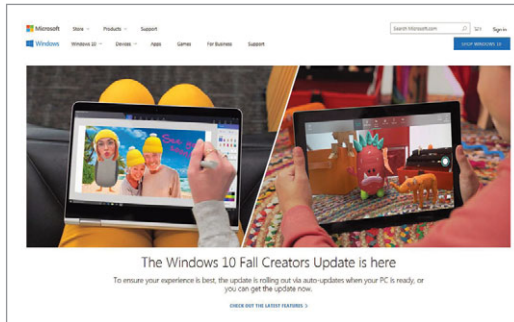
MSI Ups Ante With GAMING X TRIO

MSI plans to have another graphics card based on NVIDIA's GeForce GTX 1080 Ti out in time for the holiday buying season. The MSI GTX 1080 Ti GAMING X TRIO features MSI's three-fan TRI-FROZR cooling technology (2 x 100mm fans and 1 x 90mm fan). The TRI-FROZR can dissipate up to 300W of heat. The new graphics card has 11GB of GDDR5X memory and an effective memory clock of 11,016MHz. The GAMING X Trio has three running modes: Silent Mode, Gaming Mode, and OC Mode. Base and boost clocks for each mode are 1480/1582 (Silent); 1493/1607 (Gaming); and 1506/1620 (OC). The card includes RGB lighting that works with MSI's Mystic Light customization software. The new MSI GTX 1080 Ti GAMING X TRIO is expected to be on shelves by the middle of November.

More Affordable VR From Oculus

Facebook announced its Oculus division will be coming out with a new virtual reality headset early in 2018. The Oculus Go is a standalone VR headset, meaning it can operate without cables connecting it to a PC. Early photos of the Go show that it comes with a handheld remote control. Oculus says the Go is part of a "new phase of VR hardware." The headset is "super lightweight" and appears to be made mostly of foam and fabric. It has built-in speakers, but in case you want to be the only person who can hear the audio, it also has a 3.5mm headphone jack that you evidently will need to connect to earphones. According to Oculus, the LCD screen in the Go offers high resolution and the lenses in the headset are the company's "best ever." Oculus says the Go will arrive in Q1 next year and carry an MSRP of \$199.





Microsoft Offers Partners The First Official Look At The New Windows

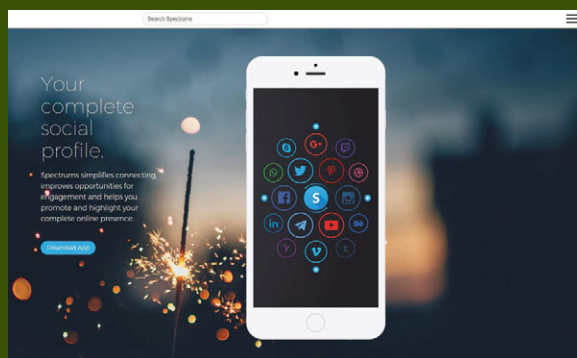
In late October, Microsoft began rolling out its latest bundle of updates for Windows, known as the Windows 10 Fall Creators Update. The new software went out to selected partner companies first to begin testing before integrating into upcoming products; then the update became available to more manufacturers and beta testers, with tweaking continuing until the final consumer version is released. Microsoft claims the Windows 10 Fall Creators Update is the most secure version of Windows ever released by the company. The software also includes new tools to streamline communications, improve the storing and retrieval of data from the cloud, and improve working with data in general from multiple sources. Oh, and Cortana gets an update, too. You can learn more about the new features of Windows 10 Fall Creators Update in the Software Tips & Projects article found in the Loading Zone section in this issue.

That Knocking Sound You Hear In Your Car Sounds Like Opportunity

An innovative startup called Data Driven is working on a smartphone app that aims to interpret the noises and shakes your car makes and tell you whether it's nothing to worry about or if it's time to make repairs. The can app also suggest what type of repairs your car may need by combining data from the microphone and accelerometers in a smartphone and then comparing those results across a database of known car mechanical sounds and movements. That shake up front? Your right tire needs balancing. That whine in back? Uh oh, that's a wheel bearing going out. Josh Siegel, a postdoctoral associate at MIT who is one of the founders of Data Driven, estimates the app could save consumers and commercial drivers hundreds of dollars a year in down time and improved gas mileage. Field testing for the app is expected to begin sometime in 2018.

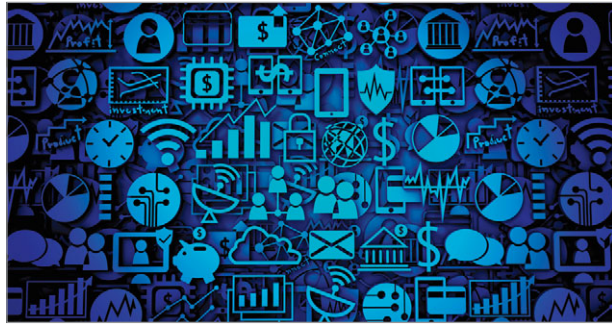


SOFTWARE SHORTS



Keeping Track Of All Your Social Media? Yep, There's An App For That

Americans are spending more and more time tweeting and posting and messaging and sharing videos these days. By some estimates, people spend as much as one-third of their online time using social media. A new app called Spectrums (download at www.spectrums.me) aims to make it easier to keep track of all your social media accounts and also share and safeguard your data. The app works by issuing you a unique SID (Spectrum ID) number; you add all your social media info once (blogs, media accounts, favorite sites, and so on), and then when you want to share that info with someone, all you need to do is share the SID instead of providing all your info time and time again. Spectrums says it already integrates seamlessly with all major social networks and plans to add more features soon.

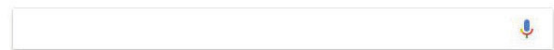


Ecommerce Share Of The Overall Retail Market Continues To Grow

We live in an age where anything digital continues to shine, at least as far as pop culture, the stock market, and retail sales are concerned. Brick-and-mortar retail king Walmart may be sitting at the top of the latest Fortune 500 list with nearly \$486 billion in revenues, but alas, those sales are up less than 1% over last year, and the retailer is only valued by investors at about \$219 billion. Meanwhile, online giant Amazon has cracked the top dozen in Fortune's annual listing, coming in at #12 with total revenues of about \$136 billion. Amazon's revenues are less than a third the size of Walmart's, but sales have increased more than 27% over the previous year, so investors have rewarded the company with a market value of \$423 billion. Amazon has plenty of wind at its back, too, as ecommerce sales are projected to continue eating away at the overall retail market. ABI Research projects ecommerce's share of the overall retail market will reach 25% by the year 2025.

Now You Can Buy Something Online & Pay For It Using Google

Back in May, Google announced it was working on a payments system that would allow you to pay for online purchases via Google. Now the company has formally launched the new service. Basically, what Google has done is aggregate all the credit card info you have already entered through any Google property, service or app, such as buying something on Google Play or through YouTube. It takes that data as well as your personal address, phone number, and other pertinent info and makes it easy to transfer that data to merchants when you buy something online. So instead of having to reenter your street address, phone number, email address, credit card number, and so on each time, you just select Pay With Google and make a few clicks. Google is already working with many merchants and is making its Google Pay API available to developers. Learn how the service works at <http://bit.ly/2yJtdZq>.



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RallyUp.com Wants To Simplify Fundraising For Small Organizations

There are websites that help inventors patent ideas and help startups raise capital to launch new products. Now there's a site that wants to make it easier for schools, charities, communities, and other groups to organize fundraisers. RallyUp.com is a for-profit company, but its services are strictly for fundraisers that benefit charities and non-profits. The RallyUp website offers an online fundraising platform that walks users through all the details of creating, organizing, and holding a fundraiser. The site lets you run fundraising campaigns and manage donors. There is no cost up front; you pay for the services and tools on RallyUp.com by selecting among several options tied to the funds you raise. Planning a charity-based LAN? Check out the services available at www.rallyup.com.



Job Of The Month

Few areas of computing science are as forward-looking (or as sci-fi sounding) as quantum computing. And in this rarified field, D-Wave Systems, a privately held company founded in 1999, stands out as the world's first quantum computing company. In 2010, the company released its first commercial quantum computer, and subsequent generations of systems have helped continue propelling the industry forward. D-Wave is looking for a DevOps System Engineer for its offices in Burnaby, British Columbia. This position is responsible for creating and maintaining the company's development environments, including those in production. Applicants should have five years or more experience working with Linux (esp. Ubuntu and Red Hat) and must be knowledgeable about NFS and similar distributed file systems. You should be a scripting guru (Python, Ruby, etc.) and understand the ins and outs of IP networks, HTTP, VPNs, and Cisco's networking and security gear. If qubits are your thing, submit your app at the site below.

Source: www.dwavesys.com

Can't Talk Right Now; I'm On Facebook

The social media juggernaut known as Facebook continues to entrench itself deeper and deeper into the lives of people all over the globe. According to statistics pulled together from various sources by the marketing firm Zephoria.com, more than two billion people have accounts on Facebook (that's about 28% of all humans), and about 1.32 billion of them log into FB every day. The lure of Facebook is especially strong with young adults. About 30% of Facebook users are ages 25 to 34, and in the U.S., 50% of people ages 18 to 24 say they check Facebook when they wake up each morning. For more fun info, see the stats at right.

Source: various via Zephoria.com

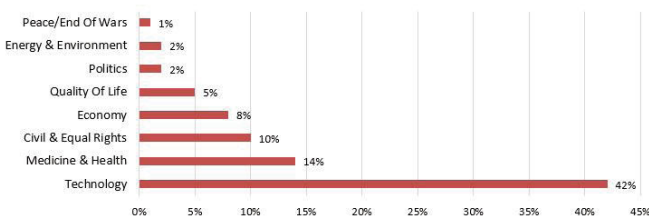
Every Day On Facebook . . .

- **432,000** new profiles are created
- users upload **300 million** photos
- **422 million** statuses are updated
- people post **734 million** comments
- **1.15 billion** users log in via mobile devices

We Sure Like Our Shiny Technology

A lot can happen to a country in 50 years. We've traveled to the moon; passed legislation to address racial, gender, and sexual orientation inequalities; cleaned up our air and water; reduced the stockpile of nuclear weapons in the world; and witnessed the rise of personal computers and the Internet. But according to a recent Pew Research survey, of all the things that have happened in the last half century in all spheres of life, American adults say it's technology that has had the biggest impact on life in the U.S.A. Seeing as how we're a publication for people who love computers, we're not going to argue too

What has been the biggest improvement to life in America over the past 50 years? (Percentage of U.S. Adult Respondents)



much with that assessment, but we would humbly suggest the Cubs winning the World Series has to rank right up there.

Source: Pew Research Center

RAW Numbers:

9%

The percentage of broadband households in the U.S. that are forecast to buy a smartwatch during 2018. Approximately 14% of broadband households already own a smartwatch. By comparison, nearly three quarters of U.S. households own a digital tablet.

Parks Associates

17

The number of qubits, or quantum bits, that Intel's new quantum computing processor works with at one time. Intel designed the quarter-sized processor as part of its ongoing research into quantum computing.

Intel

25

The number of gigabytes of data a modern automobile is estimated to produce every hour. Of that amount, only one or two kilobytes is currently stored and fully utilized.

MIT Researcher & Post Doctoral Associate Josh Siegel, via the MIT Alumni Association's "Slice Of MIT"

64%

The percentage of Americans who own a product made by Apple. This includes computers, tablets, smartphones, smartwatches, and other digital devices. The average American household contains 2.6 Apple products.

CNBC

78%

The percentage of people who report using some type of encryption or other security tools to protect their privacy when using connected devices.

ReportLinker



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Something For Everyone

We Review Eight Cases From \$79.99 To \$469.95

They say clothes make the man, and that's probably true to a certain extent, but if so it's probably equally true to say a case makes the PC. The case you choose for your system in some instances can mark it pretty quickly as a utilitarian general-use PC, a high-end gaming PC, or a massive HEDT monster that can game, stream, edit video, mine Bitcoin, and much more—and do it all in style.

There are myriad shapes and sizes of cases, and they come in a wide range of prices, so we put together a roundup of eight enclosures that range from less than a Benjamin to nearly five Benjamins to give you a good idea of what's out there in case you're starting to think about your next build.

CaseLabs Mercury S8

CaseLabs is one of the foremost names in the case market; the company has been making quality PC enclosures for all kinds of builds since 2010, and its designs have been imitated but never duplicated. The company's products are well-known to high-end builders and everywhere because they provide lots of flexible space, are easy to tinker in, and usually represent an excellent canvas for creative builders to mod to their hearts' content.

The Mercury S8 is a cube case constructed from stout aluminum panels and rails and is about the same height and depth as most standard mid-towers, but because of its substantial width, it presents builders with options that many cases do not. Its motherboard tray is horizontal and separates the case into two distinct zones for cooling and aesthetic purposes, the top being an open space for your motherboard, CPU, graphics cards, and liquid-cooling gear you don't feel like stowing out of sight below the motherboard tray. The bottom compartment

Mercury S8

\$469.95 | CaseLabs | www.caselabs-store.com

Specs: Dimensions: 18.74 x 14.54 x 19.03 inches (HxWxD); Material: Aluminum; Motherboard support: Mini-ITX, mATX, ATX, EATX; Bays: 9 Flex-Bays (5.25-inch), 2 HDD cages (supporting 4 HDD or SSDs each), up to 4 stealth-mount SSDs, up to 6 HDDs (2 stealth-mount); CPU cooler clearance: 10.2 inches; Radiator support: 120, 240, 140, 280, 360mm); Ports: 4 x USB 3.0, audio I/O

is also purpose-built to accommodate your system's power supply and storage drives.

You don't have to spend too much hands-on time with the S8 to know that it is an extremely well-built case; some cases feel solid enough until you pull a panel off here or a door off there, and then things get a little less impressive. Not so with this case: It feels every bit as strong and stable with the side panels off (and they have quick-release

mechanisms built in, so they are surprisingly easy to take off and put back on) as it does when they are in place.

The S8's aluminum construction and numerous ventilation and cooling options make it relatively easy to cool. Speaking of options, CaseLabs offers more than a few with the Mercury S8. It comes with either a black or gunmetal (for an upcharge) exterior finish, you can select from among four



internal finish color options, and there are numerous choices you can make for each panel and door throughout the chassis. These options will make ordering this case a little more complicated than picking up a standard mid-tower off the shelf, but it also ensures that you get a case that exactly represents the vision you have for your PC build.

With a basic ordering price of \$469.95, the Mercury S8 is also the most expensive case in this roundup by a considerable margin, but for many builders it's not an exaggeration to

COUGAR CONQUER

COUGAR has a full range of PC cases, including small form factor units, cavernous full-tower chassis, and everything in between, and including all kinds of styles. But the company's latest case, an open-frame concept mid-tower called the CONQUER, is something else entirely.

When you see the phrase "open frame," you probably envision a squat, horizontal test bench frame, but the CONQUER is anything but. It stands vertically like a standard

connect the CONQUER's twin tempered-glass panels to the rest of the case at five points, but there's a good inch and a half between the rest of the CONQUER and the glass, and the aforementioned panels are hardly the solid sheets of aluminum you see elsewhere. COUGAR calls the style of their panels "truss-aesthetics," which refers to architectural trusses, and it's easy to see why. Like a building truss, the aluminum top and front portions of this case are light but very strong, and they allow for a largely unimpeded flow of air into and out of the structure, which most PC builders know to be a good thing.

It's important to note that while most cases on the market today are more or less fully assembled out of the box (sometimes you have to attach a tempered-glass side panel), the CONQUER shows up with some assembly required. The front and top of the case are mostly together, but you need to make the CONQUER complete by installing the aluminum bars, the glass, and a few brackets for internal components. The included instruction manual is reasonably helpful, though, and outlines the process in such a way that you can build your system while assembling the case.

When fully assembled, the CONQUER is about as visually striking as cases get; it looks like something you might see in Halo 5, or maybe a PC case crossed with a Ducati Diavel. It looks ultra-modern, fast, and cool. It also has a well-designed interior that's flexible enough for just about any kind of system you want to build in it; we could talk about the inventive ways COUGAR lets you mount your drives or install your power supply in the absence of a traditional frame, but let's face it: If you buy this case, you're doing it primarily for its killer looks, and the CONQUER delivers.

COUGAR has the CONQUER for sale on Newegg for \$279.99 plus \$9.99 shipping to anywhere in the United States. The price tag and its slightly higher-than-average technical requirements may mean that it's not for everyone, but again: You get this case for its distinctive looks, not because everyone you know has one. *CPU* doesn't have a Sexiest Case Of The Year award, but if we did, the COUGAR CONQUER would win it every day and twice on Sunday.



CONQUER

\$289.98 (Newegg price; includes shipping) | COUGAR | cougargaming.com

Specs: Dimensions: 23 x 10 x 27 inches (HxWxD); Materials: Aluminum alloy, tempered glass; Motherboard support: Mini-ITX, mATX, ATX; Drive bays: Up to 3 3.5-inch internal, Up to 4 2.5-inch internal; Fans (included): 2 x 120mm LED front, 1 x 120mm LED top; Fans (optional): 2 x 120mm top; Ports: 2 x USB 3.0, audio I/O

say that this will be the last case you'll ever need. It is a joy to build in, and it has more than enough room inside to make frequent tinkering a pleasant experience, as well. Combine these factors with the CaseLabs' legendary construction quality, and you have a case that's likely to outlast every other computer part you buy from this day forward.

mid-tower, and it has front, top, and side panels, but where most cases have a back panel, the CONQUER has . . . open air. There are a couple of horizontal aluminum bars that maintain the integrity of the side panels at the rear, but those aside you can see your motherboard and pretty much all of your components at a glance. The aluminum bars

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT

be quiet! Dark Base Pro 900 White Edition

We reviewed the original Dark Base 900 and Dark Base Pro 900 last year in early summer, and we were so impressed at the time that we gave the case(s) our seldom-used *CPU* Cutting Edge Award, given to products that redefine the function and/or capabilities of their product category by virtue of forward-thinking, innovative design.

The latest addition to the family, the Dark Base Pro 900 White Edition, is similarly impressive, even after having been on the market for a little over a year. This is due largely to the fact that the DBP is still one of if not the most flexible cases a builder can get his mitts on. You can mount your power supply in any of six positions, you can remove the case's seven-drive cage or rotate it to face the opposite direction, and you can invert the motherboard tray (if you want it to face the right side instead of left) or just move it to one of three height settings (handy for folks who favor thicker radiators mounted beneath the top panel). You can even take the tray out altogether and either pre-install your board and primary components or leave it out for a while and use it as a test bench for troubleshooting hard-to-diagnose hardware issues.

The case supports motherboards ranging from Mini-ITX boards to EATX monster boards, a wide variety of fan and radiator configs, and comes with LED strips that you can place anywhere in the case and then set to one of five colors. And like the original Dark Base Pro 900, the White Edition comes with an integrated wireless charger for Qi-enabled phones. be quiet! ships the case with three of its uber-quiet SilentWings 3 140mm PWM fans; there are 140mm and 120mm mounts in the front, at the top, and on the bottom.

As its name suggests, there's one pretty major difference between this case and the original DBP 900: Instead of be quiet!'s customary black and silver, black and black, or black and orange color scheme, this one is swathed in white with a bit of black trim here and there. It's a great look for this case, and the interior matches the outside. Additionally, be quiet! says this case will be a limited-edition chassis with a production run of just 2,000

units. Each one comes with an aluminum badge inside that denotes the case's limited edition status and lists that unit's specific production number out of 2000.

White cases aren't as rare today as they used to be. In fact they're pretty easy to find. But the Dark Base Pro 900 White Edition is more than just another pretty case: It's one of the most highly configurable cases we've seen to date, and it maintains be quiet!'s

Master, the MasterCase H500P, ticks all of those boxes and more.

It's the first member of the MasterCase family to have both a tempered-glass side panel and a fully transparent front panel, and it capitalizes on that transparency by shipping the case with two 200mm RGB fans preinstalled up front. And although the case doesn't have its own LED controller, the fans are compatible with



Dark Base Pro 900 White Edition

\$269 | be quiet! | www.bequiet.com

Specs: Dimensions: 23 x 9.6 x 22.7 inches (HxWxD); Materials: Aluminum, ABS plastic, steel, tempered glass; Motherboard support: Mini-ITX, mATX, ATX, XL-ATX, EATX; Drive bays: 2 x 5.25-inch external, 7 x 3.5-inch internal, 15 x 2.5-inch internal; Fans (included): 2 x 140mm front, 1 x 140mm rear; Fans (optional): 1 x 140mm front, 4 x 120mm/3 x 140mm/1 x 180mm top, 2 x 140mm/1 x 120mm bottom; Ports: 2 x USB 3.0, 2 x USB 2.0, audio I/O

reputation for making chassis that provide exceptional cool and quiet operation.

Cooler Master MasterCase H500P

Cooler Master has done a pretty good job the last few years of giving builders cases that look great and that are suitable canvasses for all sorts of creative mods; more importantly, the company's cases are easy to build in. The newest effort from Cooler

RGB control suites from several major motherboard manufacturers, including ASUS (AURA SYNC), GIGABYTE (RGB Fusion), MSI (Mystic Light Sync), and ASRock (RGB LED). The case also comes with a 1-to-3 splitter cable for RGB fans with 4-pin adapters, so that you can install the three top fans the case supports and tie their RGB effects in with those of the big 200s up front.

The H500P also deviates a bit from previous MasterCase models by doing away with the smooth, clean panels and edges that typify the series, replacing them with a design that looks and feels more industrial. The edges of the top and front panels are trimmed with plastic vents lined with steel mesh that help keep the air flowing around all of the glass and clear plastic that helps make the fans pop when they light up.

As unique as the H500P's outside is, though, it's when you get inside that the case really shines. Cooler Master's FreeForm modular system for PC configuration is still front and center inside this case, but now the

cutout for CPU cooler mounting now comes with a plastic cover piece that easily snaps into place over the entire cutout, and that is deep enough to comfortably accommodate the mounting hardware and so forth behind the tray. Cooler Master claims to have pioneered motherboard tray cutouts, and they are the first we've seen to cover them back up.

Additionally, the H500P divides the power supply shroud into two parts, the furthest forward of which is easily removable in the event that you want to mount a radiator behind the front panel (up to 360mm) or you have removed the drive bay cage beneath and want to mount

comes out with two screws and is designed to cover all of the cables that run along your motherboard's forward edge.

The upshot is that the MasterCase H500P isn't just flexible; it also makes a build with super-clean internals the easiest it's ever been. Oh, and one other thing: Cooler Master knows that for many DIY rigs, the graphics card is the king of the components. So rather than force you to look through the tempered glass at just your card's top edge, the company added two vertical PCI slots out near the left side of the back panel that you can use to mount your GPU vertically and give it center stage in your build. Bravo, Cooler Master.



MasterCase H500P

\$149.99 | Cooler Master | www.coolermaster.com

Specs: Dimensions: 21.3 x 9.5 x 21.4 inches (HxWxD); Materials: Steel, plastic, tempered glass; Motherboard support: Mini-ITX, mATX, ATX, EATX; Drive bays: 2 x 2.5-/3.5-inch internal, 2 x 2.5-inch internal; Fans (included): 2 x 200mm RGB LED front, 1 x 140mm rear; Fans (optional): 3 x 120mm/140mm front, 3 x 120mm/140mm or 2 x 200mm top, 1 x 120mm rear; Ports: 2 x USB 3.0, 2 x USB 2.0, audio I/O

company has added a whole new wave of internal features to extend a clean, structured look to all of that modularity. For starters, you'll notice that the big motherboard tray

a reservoir or some such in its place. There's also a new vertical metal shroud that runs top to bottom along the front portion of the back of the motherboard tray; it installs and

ENERMAX EQUILENCE

ENERMAX sent us a brand-new mid-tower called the EQUILENCE for this month's roundup, a steel case with a tempered-glass side panel on the left side, a steel panel insulated with sound-deadening material on the right, and a top panel that provides either more sound dampening power or more ventilation, depending on your needs. This case looks good, is well built, and continues ENERMAX's tradition of solid case design.

The EQUILENCE is built for quiet, high-end computing, and its baffled air intakes along the front of the left and right sides are part of an effective cooling system that we've seen used in silent case designs for a number of years now. The steel top panel contains a fair amount of ventilation along with mounting holes for up to three 120mm fans and/or a 360mm radiator, but if you value quiet over ventilation, you can leave the solid magnetic cover that ships fastened to the panel in place. Like the EQUILENCE's right side panel, the top panel cover is equipped with sound-deadening material.

The front panel also accepts fans and radiators up to 360mm in length. Two 120mm fans come pre-installed up front, as does a single 140mm unit in the rear. Additional cooling potential exists in the form of a pair of fan/radiator mounts on inside of the motherboard tray towards the front; you can install radiators up to 240mm long there, as well, so as you can imagine,

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT



EQUILENCE

\$109.99 | ENERMAX | enermaxusa.com

Specs: Dimensions: 20 x 9.25 x 19.7 inches (HxWxD); Materials: Steel, plastic, tempered glass; Motherboard support: Mini-ITX, mATX, ATX; Drive bays: 2 x 2.5-/3.5-inch internal, 4 x 2.5-inch internal; Fans (included): 2 x 120mm front, 1 x 140mm rear; Fans (optional): 1 x 120mm, 2 x 140mm/3 x 120mm top, 2 x 120mm side, 1 x 120mm rear; Ports: 2 x USB 3.0, 2 x USB 2.0, audio I/O



P7-C0

\$99.99 | Aerocool | www.aerocool.us

Specs: Dimensions: 18.4 x 8.4 x 17.6 inches (HxWxD); Materials: Steel, plastic, tempered glass; Motherboard support: Mini-ITX, mATX, ATX; Drive bays: 2 x 2.5-/3.5-inch internal, 2 x 2.5-inch internal; Fans (included): 1 x 120mm rear; Fans (optional): 3 x 120mm/140mm front, 2 x 120mm/140mm top, 1 x 140mm rear; Ports: 2 x USB 3.0, audio I/O

you can build a rig with considerable liquid-cooling power in this case.

In addition to being quiet and cool, the EQUILENCE also has a great look; this starts up front with its glossy black front panel and LED-lit ENERMAX logos that run along the front of both the left and right panels in between intake vents. The case's tempered glass panel has the usual mounting bolts and is both attractive and easy to remove or install, and there's one more very cool little aesthetic touch: The buttons and I/O ports along the front of the top panel are also LED-backlit, a feature you don't see very often but that adds a lot of visual flair.

The EQUILENCE accepts installation of up to two 3.5-inch drives and/or as many as six 2.5-inch drives if you include the dual-bay drive cage beneath the power supply shroud (which is nearly a universal feature on most modern cases), the two removable 2.5-inch drive mounting brackets on the back of the motherboard tray, and if you elect to use the interior mounting holes toward the front of the mobo tray that share space with fan/radiator mounting holes. The case's cavernous interior supports the installation of graphics cards a hair longer than 16.5 inches (if you install a radiator on the motherboard tray forward of the board, you'll have a little over 11 inches), as well as Mini-ITX, microATX, and ATX motherboards.

ENERMAX's EQUILENCE is a solid, well-built case that we suspect will win over lots of builders with its classy modern looks and high degree of flexibility. This is the best ENERMAX case in years, and possibly the best one ever.

Aerocool P7-C0

We first saw Aerocool's P7-C0 back in May; the case was the second item in the company's new Project 7 line of products, which seem to mark a new direction in design for Aerocool. Project 7 items have clean yet interesting lines and are generally a big step forward for the company aesthetically. The P7 line has since grown to also include a power supply. (Look for our review of the P7-850W Platinum elsewhere in this issue.) Although this case's predecessor, the P7-C1, benefitted from a design that comes off as somewhat bolder than the P7-C0's, this case has the dual



METEOR-XR & METEOR-XR PLUS

\$79.99 | Rosewill | www.rosewill.com

Specs: Dimensions: 19.26 x 8.27 x 17.25 inches (HxWxD); Materials: Steel, plastic, tempered glass; Motherboard support: Mini-ITX, mATX, ATX; Drive bays: 1 x 5.25-inch external, 2 x 2.5-/3.5-inch internal, 2 x 2.5-inch internal; Fans (included): 1 x 120mm front, 1 x 120mm LED rear; Fans (optional): 1 x 120mm/2 x 140mm front, 2 x 120mm/140mm top; Ports: 2 x USB 3.0, 1 x HDMI (VR), audio I/O

tempered-glass panels that are all the rage these days (the P7-C1 had just one acrylic side-panel window), and combines it with the cool LED accent ring that runs around the steel mesh inset in the middle of the case's front panel.

Aerocool's stock product art generally shows the light ring set to blue, which looks great along with the black panels and the tempered glass, but you can choose from 10 colors (red, orange, yellow, green, cyan, blue, white, navy, purple, or pink), which means that more likely than not you can find a color that will match the internal color scheme you have in mind. You can have the ring light up with a static color, set it to Breathing mode, or have it cycle through all 10 colors.

Inside, the P7-C0 is ready for building, with its modern motherboard tray complete with a slight overhang from front to back for easy cable management. Like the glass side panels, this is a design feature that we've

been seeing a great deal more this year, and it makes good sense. The interior also boasts a nearly full-length power supply shroud and a hidden dual-bay drive cage. There are additional 2.5-inch drive mounts on the back side of the motherboard tray, as well, so your motherboard, CPU, and graphics card(s) will be the stars of the show.

Aerocool also smartly gives builders a little breathing room above the top of the motherboard mounting area and the top of the case, which will come in handy if you want to install a radiator up there. Thanks to Aerocool's smart design, this case can handle all of the high-end gear you can throw at it (including CPU coolers nearly 7 inches high and graphics cards just over 15 inches long) but will still look immaculately clean inside with just a smidgen of work on your part.

As you'd expect from an Aerocool case, cooling is not a problem thanks to the mesh up front, a ventilated top panel, and internal

mounts that support a large number of fan configurations. If you want to go the liquid-cooling route, you can also mount a 360mm radiator up front, a 240mm up top, and a 120mm rad at the rear.

Long story short, this is a great-looking case that will help you build a great-looking rig. And Aerocool prices it quite reasonably at just under \$100, especially considering the two tempered-glass side panels.

Rosewill METEOR-XR

The METEOR-XR is one of a flurry of new cases from Rosewill; this mid-tower combines several features that are popular among case builders these days, including a tempered-glass side panel, a plastic front panel with a texture similar to that of brushed aluminum, and a very build-friendly interior that's also free of clutter.

The case comes in two varieties: The XR and the XR Plus. The XR Plus is distinguished by its white steel power supply shroud and motherboard tray; these items match the rest of the interior's black in the standard XR model. Either way, the shroud is both aesthetically advantageous and functional, as it both hides the PSU and its thicket of cables and provides a couple of alternate mounting spots for the case's two 2.5-inch drive mounting brackets. As you'll find in most well-designed cases, the front end of the shroud also contains a cut-out for mounting a radiator and fans behind the front panel.

Elsewhere you'll find a rear-mounted 120mm LED fan (there's a non-LED model mounted up front), a 5.25-inch drive bay near the top of the front panel, and a motherboard tray with an enormous cutout for installing a CPU cooler. The tray also has a staggered split just forward of the front mobo screw holes that neatly hides all but the very ends of your ATX 24-pin power cable, internal SATA cables, and so on.

The METEOR-XR is an interesting blend stylistically. Its austere front panel and basic lines tend toward the understated look popularized by a certain Swedish case company, and the white interior accents go further toward that ideal, but Rosewill built an interesting, detailed red plastic accent piece into the front of the right side of the case just behind the front panel. The accent

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT

helps to break up what would otherwise be a very plain, smooth, black right side. The case also has a pretty unique spot for its power and storage activity indicator lights; you'll find them at the bottom-left corner of the front panel.

Beyond the aforementioned fans, cooling options are plentiful, as you can install as many as two more 120mm units up front (or swap in two 140mm fans instead) as well as two 120mm or 140mm fans up top beneath the ventilated top panel with its magnetic, removable dust filter. You can install a radiator up to 280mm long at the

want access to a 5.25-inch drive bay. And as is often true of Rosewill cases, the price (just 80 bones) is right.

Zalman Z9 NEO Black

This was our first brush with the Zalman Z9 NEO in black; the first time we saw the case, it arrived in white and looked great, especially given the Z9 NEO's smooth, clean lines. This time around, Zalman went back to the basics, and the results are every bit as good.

The Z9 NEO combines some time-honored features and a couple that are more novel, resulting in an enclosure that is highly

The items you don't see in a great many cases include the Z9 NEO's pre-installed Velcro cable straps and the little rubber plugs in the USB ports at the front of the top panel by the power and reset buttons. These are small touches, but they're a nice addition to the overall package, as is the front panel that swings open to the right; if you like a smooth front panel (and who doesn't?) but still want the option to install a 5.25-inch optical drive, this case gives you the best of both worlds. Just behind the door on both sides you'll find vertical vents that provide access to outside air the front fans need to pull in to keep things cool on the inside, and opening them to the sides helps cut down on ambient noise in front of the case. (This is aided by the layer of sound-dampening material Zalman adds to the inside of the front panel door.) This is a design we've liked for many years, and it still holds up today. The door latches by way of an integrated magnet, so it opens easily but stays shut when you want it shut.

It's also worth noting that Zalman ships this case with five pre-installed 120mm fans, including two up front, one in back, and two LED models beneath the top panel. Like the front I/O port plugs, this is an unusual but nice addition to the case, as many mid-towers in this price range come with two or three fans tops.

At just over 19 inches high and just less than 19 inches deep, the Z9 NEO isn't a huge case, but don't let its modest footprint fool you. The case accepts installation of graphics cards over 16.5 inches long (assuming you can find one) and is similarly roomy where CPU coolers (over six inches high) and power supplies (7.87 inches deep) are concerned.

If you like the clean, understated look that is popular these days but still want a case with front-facing 5.25-inch drive bays, the Zalman Z9 NEO Black might be the right case for you, and its budget-friendly price will save more of your system parts budget for things like graphics cards and M.2 SSDs. ■

BY CHRIS TRUMBLE



Z9 NEO Black

\$79.99 | Zalman | www.zalman.com

Specs: Dimensions: 19.29 x 8.07 x 18.98 inches (HxWxD); Materials: Steel, plastic; Motherboard support: Mini-ITX, mATX, ATX; Drive bays: 2 x 5.25-inch external (also accommodate 3.5-/2.5-inch drives), 2 x 3.5-/2.5-inch internal, 2 x 2.5-inch internal; Fans (included): 2 x 120mm front, 2 x 120mm LED top, 1 x 120mm rear; Fans (optional): 2 x 140mm front; Ports: 2 x USB 3.0, 2 x USB 2.0, audio I/O

top, and you can do the same up front unless you remove the 5.25-inch bay, in which case you can install a 360mm rad. The bottom panel also includes plentiful ventilation and a removable dust filter.

Rosewill's METEOR-XR and XR PLUS are highly functional cases that should prove perfect for users who want the clean, uncluttered interior of a modern case but still

functional and also looks pretty good but that isn't very expensive—you can find a Z9 NEO online for less than the \$69.99 that retailers offer as its suggested retail price. Common features include a ventilated PSU shroud and a two-bay cage toward the front of the case, as well as a motherboard tray with five rubber-grommated cable management slots and tie-down anchor points.

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT

**X399 DESIGNARE EX**

\$399.99

GIGABYTE

www.gigabyte.us

GIGABYTE X399 DESIGNARE EX

GIGABYTE has traditionally targeted its DESIGNARE motherboard at content creators. For example, GIGABYTE previously validated and optimized DESIGNARE-branded boards for use with NVIDIA's Quadro series graphics cards. Making a DESIGNARE board for AMD's Ryzen Threadripper processors is an obvious fit, because the CPUs massive thread count is ideal for rendering, compiling, and encoding duties. GIGABYTE's X399 DESIGNARE EX comes with several features to help creators make the most of Ryzen Threadripper and other high-end parts for multimedia professionals.

In terms of layout, the X399 DESIGNARE EX is nearly identical to the X399 AORUS Gaming 7 (\$389.99) we reviewed last month with eight DDR4 DIMM slots that support up to 128GB of memory, four PCIe 3.0 x16 slots, and three 32Gbps M.2 slots. The X399 DESIGNARE EX is \$10 more expensive than the AORUS Gaming 7, and the cost difference mostly comes from the thick

silver base plate behind the PCB. The base plate effectively reinforces the mainboard and prevents warping under the weight of heavy GPUs or large CPU coolers. The other notable hardware difference is that GIGABYTE replaces the Killer E2500 NIC with two Intel i211 Ethernet ports.

GIGABYTE does make some big visual changes with the X399 DESIGNARE EX, going with a silver and black combination and lot less LED lighting than the X399 AORUS Gaming 7. The silver aesthetic is similar to what we've seen in recent GIGABYTE motherboards since the company introduced the AORUS brand. There is some nice LED illumination under the DESIGNARE logo on the PCH heatsink, so the mainboard is not completely devoid of LEDs. To connect third-party RGB components, the mainboard has one digital LED header and two RGBW headers.

Reliability and component stability have always been important to content creators, and there are several additions

to improve the motherboard's lifespan. Precise power is delivered to the CPU via all digital PWM controllers that distribute thermal loads among multiple PowIRstage ICs. The VRM area also features server-level chokes, as well as a tiny fan behind the rear I/O to actively cool the VRM. To keep M.2 thermals in check, GIGABYTE includes metal heat shields for all three M.2 slots.

Multimedia professionals, in general, require high-speed connectivity and plenty of storage to transfer media files. GIGABYTE equips the X399 DESIGNARE EX with two USB 3.1 ports on the rear I/O panel (one Type-C and one Type-A), as well as a USB 3.1 header for front panel USB 3.1 access. The rear I/O panel also features eight USB 3.0 ports with digital fuses to protect against overcurrent damage.

In addition to the three M.2 ports, GIGABYTE includes an M.2 to U.2 adapter and eight 6Gbps SATA ports. AMD's recent addition of NVMe RAID support over Ryzen Threadripper

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opens up new opportunities for storage enthusiasts. With a single GPU in the system, the X399 DESIGNARE EX supports up to six PCIe SSDs in RAID 0, 1, or 10 array. In such a configuration, you'd have one GPU in the top PCIe x16 slot and the remaining PCIe 3.0 x16 slots would be filled with M.2 add-in cards (these are not included). You'd also fill up the three M.2 slots with PCIe SSDs. RAID configurations are also supported over the eight 6Gbps SATA ports.

Internet connectivity is provided by the dual Intel i211 Ethernet ports, and both NICs support traffic management over the included cFosSpeed utility. Similar to the Killer software found on the X399 AORUS Gaming 7, cFosSpeed allows you to adjust network priority to applications and will automatically prioritize packets for online games. Wireless connectivity is onboard as well, via an Intel wireless module that supports 802.11a/b/g/n/ac and Bluetooth 4.2.

The GIGABYTE X399 DESIGNARE EX, as we would expect, scored similarly to the X399 AORUS Gaming 7 in our benchmark tests. Results in Cinebench

15 (2,961 points) and POV-Ray 3.7 (5,720 pixels per second) showcase what AMD's Ryzen Threadripper 1950X can accomplish when 32 threads are put to use. Gaming at 2,560 x 1,440 was no problem with our test system's GIGABYTE AORUS GeForce GTX 1080 Ti 11G. Frame rates registered well above 100fps in Metro: Last Light and Sniper Elite 4, while the Witcher 3 hit 93ps.

Motherboards aimed at content creators aren't typically as exciting for enthusiasts as their "gaming" counterparts, but that's not the case with the X399 DESIGNARE EX. It's as full featured as the X399 AORUS Gaming 7 and we like the base plate addition, because the plate should help to ensure the longevity of the mainboard. Builds based on this motherboard should be able to achieve whatever real-world productivity content creators require. ■

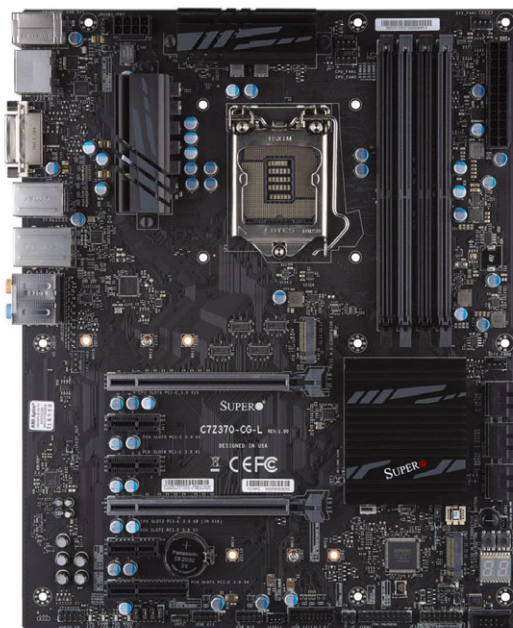
BY NATHAN LAKE

Specs: Max memory: 128GB (DDR4-2667; Max OC: DDR4-3600); Slots: 4 PCIe 3.0 x16 (2 at x16, 2 at x8), 1 PCIe 2.0 x16 (wired at x4); Storage: 3 M.2 (1 type 2242/2260/2280, 2 type 2260/2280/22110), 8 6Gbps SATA; Rear I/O: 2 USB 3.1 (1 Type-A, 1 Type-C), 8 USB 3.0, 1 PS/2, 2 Ethernet, audio I/O, 1 S/PDIF, two antenna connectors; Form factor: ATX; Warranty: 3 years

Test System Specs: Processor: AMD Ryzen Threadripper 1950X; GPU: GIGABYTE AORUS GeForce GTX 1080 Ti 11G; Memory: 32GB HyperX Predator DDR4-3000; Storage: 480GB Patriot Hellfire; OS: Windows 10 Enterprise

Benchmark Results	GIGABYTE X399 DESIGNARE EX
3DMark Fire Strike	13218
Graphics Score	13700
Physics Score	25793
PCMark 10	5402
Essentials	8210
Productivity	6845
Digital Content Creation	7590
SiSoftware Sandra 2017 SP2	
Dhrystone AVX2 (GIPS)	520
Whetstone AVX (GFLOPS)	374
Multi-Media Integer AVX2 x32 (Mpixels/s)	1,000
Multi-Media Long-int AVX2 x16 (Mpixels/s)	326
Multi-Media Quad ALU x1 (Mpixels/s)	11
Floating B/F AVX/128 (GBps, mem bandwidth)	56.3
CrystalDiskMark 5.2.2 (MBps)	
Sequential Read (Q32T1)	2770
Sequential Write (Q32T1)	1257
Random 4K Read (Q32T1)	436.2
Random 4K Write (Q32T1)	341
POV-Ray 3.7 (Pixels/s)	5720
Cinebench 15 (Points)	2961
Games	(2,560 x 1,440)
Metro: Last Light (Very High, 16xAF, SSAA off)	105fps
Sniper Elite 4 (VSync off, Ultra, DX12)	144fps
Witcher 3: Wild Hunt (Vsync Off, Unl. FPS, Ultra)	93fps

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**SUPERO C7Z370-CG-L**

\$179.99

Supermicro

www.supero.com

Supermicro SUPERO C7Z370-CG-L

With each new CPU generation, Supermicro makes steady improvements to its SUPERO lineup of motherboards. Recent SUPERO mainboards, including the new C7Z370-CG-L, display suitable fit and finish, as well as the features and connectivity consumers have come to expect. Supermicro has come a long way since the company's first Z87 and X99 options that featured a blue PCB and bright blue slots and heatsinks.

The "CG" in the product title means that this board is part of SUPERO's Core Gaming line that "focuses purely on the essentials for professionals, gamers, or anyone who seeks a solid, well-rounded board," according to Supermicro. You won't find any RGB LEDs, overly decorative heatsinks and rear I/O covers, or multitudes of software utilities to manage the various onboard devices. In short, the SUPERO C7Z370-CG-L's vibe is much more utilitarian, though there's enough connectivity and resources to meet the needs of your average power user.

Support for Intel's 8th Generation processors are the biggest upgrade with the Z370 chipset, and on the SUPERO

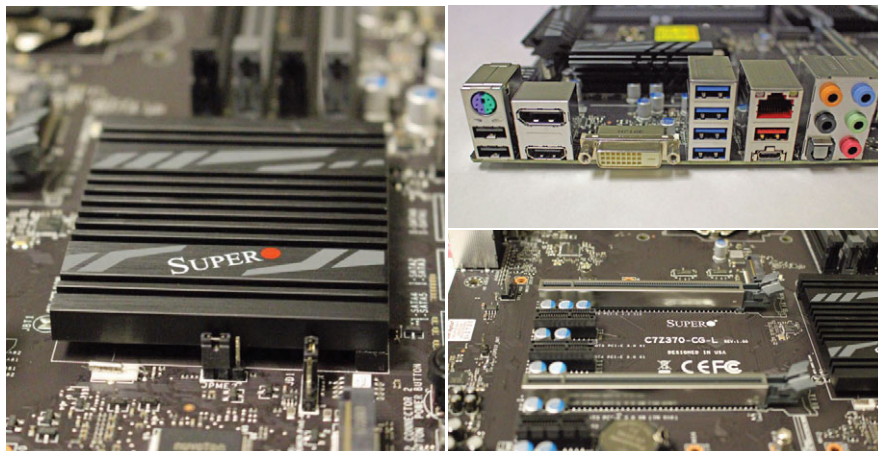
C7Z370-CG-L, Supermicro uses gold plating that's 15 microns thick on the CPU socket to virtually eliminate galvanic corrosion for long term reliability. Supermicro also installs decently sized heatsinks over the VRM (a 5+2 phase system), which should help to support the extra power delivery necessary for Intel's new 6-core processors. The PCH boasts a large, flat heatsink, as well. Speaking more generally, SUPERO motherboards provide solid peace of mind, because they must pass many of the same rigorous testing processes Supermicro runs on its server motherboards.

The C7Z370-CG-L's expansion slot selection is similar to the other mid-range Z370 motherboards we've seen, but the layout of these slots is a bit smarter. There are two PCIe 3.0 x16 slots that support a CrossFire multi-GPU configuration, as well as three PCIe 3.0 x1 slots and a PCIe 3.0 x4 slot. We like that Supermicro puts two slots worth of space between the two x16 slots, because it leaves some breathing space between two dual-slot GPUs. The layout also allows you to install the larger factory overclocked GPUs that overhang more than two slots.

In the bottom PCIe 3.0 slot, a lot of similarly priced boards will put in a full x16 slot that is only wired for x4 speed. Supermicro instead opts for a PCIe 3.0 x4 slot, which avoids consumer confusion as to what add-in cards you can install into the slot. One of the best uses for the x4 slot is a PCIe SSD add-in card, and Supermicro tells us that add-in cards can boot from this slot. For those planning on using M.2 SSDs, there are two M.2 slots that both support type 2260/2280/22110 drives. We'd bemoan the lack of support for type 2242, as this form factor is often supported on other Z370 motherboards, but there are so few type 2242 drives available that this loss is insignificant.

The two M.2 slots support RAID 0 or 1 configurations made up of PCIe SSDs. If you want to create a RAID for your HDDs or SATA SSDs, the board supports RAID 0, 1, 5, or 10 configurations over the six 6Gbps SATA ports. The M.2 slots and 6Gbps SATA ports are both powered by the chipset and don't share bandwidth with each other—nor the bottom PCIe x4 slot. We like the switchless distribution of potential storage connections, because power users won't

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT



need to worry about what ports will or won't be available during installation.

System memory support is one area where the SUPERO C7Z370-CG-L doesn't quite match up with other mid-range Z370 motherboards. As of press time, the board only supports overclocked memory at up to 2,800MHz, which is barely above the stock DDR4-2666 support on Intel's Core i7 and Core i5 processors. Supermicro tells us that speeds should increase with future firmware updates.

Rear I/O and front panel connectivity is solid on the SUPERO C7Z370-CG-L. On the rear panel, Supermicro provides two USB 3.1 ports (one Type-A, one Type-C), as well as four USB 3.0 ports, two USB 2.0 ports, and a PS/2 port. Internal headers provide you another two USB 3.0 ports and four USB 2.0 ports. The rear panel's Ethernet port is controlled by Intel's i219V NIC. If you plan on using the Coffee Lake processor graphics, you should like that Supermicro includes a variety of video outputs with one HDMI port, a DisplayPort output, and a DVI-D port.

We benchmarked the SUPERO C7Z370-CG-L after adding Intel's Core

i7-8700K, EVGA's GeForce GTX 1080 Ti FTW3 GAMING, and 32GB HyperX Predator DDR4-2666. Our test system did well in 3DMark's Fire Strike Extreme test with an overall score of 13,284, highlighted by a Graphics Score (GPU intensive) of 14,131 and a Physics Score (CPU intensive) of 18,745. Frame rates in our gaming tests were nearly identical to other Z370 motherboards we've tested with the GeForce GTX 1080 Ti FTW3 GAMING. Average frame rates were 147 in Sniper Elite 4, 123 in Metro: Last Light, and 97 in Witcher 3.

Supermicro positions this motherboard as a solid, reliable option for system builders. We particularly like the expansion slot layout and PCIe lane distribution. Some power users might prefer a mid-range Z370 motherboard that supports faster memory, but if you're looking a Z370 motherboard that keeps things simple—instead of loading up on LED lighting and other embellishments—the SUPERO C7Z370-CG-L might be for you. ■

BY NATHAN LAKE

Specs: Max memory: 64GB DDR4 (DDR4-2666; Max OC: DDR4-2800); Slots: 2 PCIe 3.0 x16, 3 PCIe 3.0 x1, 1 PCIe 3.0 x4; Storage: 2 M.2 (type 2260/2280/22110), 6 6Gbps SATA; Rear I/O: 1 HDMI 1.4, 1 DisplayPort 1.2, 1 DVI-D, 1 PS/2, 2 USB 3.1 (1 Type-A, 1 Type-C), 4 USB 3.0, 2 USB 2.0, 1 Ethernet, 1 S/PDIF, audio I/O; Form factor: ATX; Warranty: 3 years

Test System Specs: Processor: Intel Core i7-8700K; GPU: EVGA GeForce GTX 1080 Ti FTW3 GAMING; Memory: 32GB HyperX Predator DDR4-2666; Storage: XPG 256GB GAMMIX S10; OS: Windows 10 Enterprise

Benchmark Results	Supermicro SUPERO C7Z370-CG-L
3DMark Fire Strike	13284
Graphics Score	14131
Physics Score	18745
PCMark 10	5390
Essentials	8754
Productivity	7732
Digital Content Creation	7501
SiSoftware Sandra 2017 SP2	
Dhrystone AVX2 (GIPS)	243.1
Whetstone AVX (GFLOPS)	174.6
Multi-Media Integer AVX2 x32 (Mpixels/s)	844
Multi-Media Long-int AVX2 x16 (Mpixels/s)	305
Multi-Media Quad ALU x1 (Mpixels/s)	4.9
Floating B/F AVX/128 (GBps, mem bandwidth)	27.8
CrystalDiskMark 5.2.2 (MBps)	
Sequential Read (Q32T1)	1376
Sequential Write (Q32T1)	954
Random 4K Read (Q32T1)	275
Random 4K Write (Q32T1)	576
POV-Ray 3.7 (Pixels/s)	2800
Cinebench 15 (Points)	1390
Games	(2,560 x 1,440)
Metro: Last Light (Very High, 16xAF, SSAA off)	123fps
Sniper Elite 4 (VSync off, Ultra, DX12)	147fps
Witcher 3: Wild Hunt (Vsync Off, Unl. FPS, Ultra)	97fps

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT



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GIGABYTE Z370 AORUS Ultra Gaming

GIGABYTE hits the ground running with the Z370 chipset. With today's launch, the company announces six AORUS-branded motherboards and three GIGABYTE boards. The premium AORUS lineup features a new VRM and PWM design that drives 60 amps per power phase, and according to GIGABYTE, the improved power handling helps to strengthen the signal between Intel's 8th Generation processor and the voltage regulator. Improved power delivery to the CPU is one of Intel's notable enhancements with the Z370 chipset, because Intel needed a way to support additional cores on the 8th Generation chips and improve overclocking capability. Anything GIGABYTE can do to further fuel overclocking efforts, therefore, is something we appreciate.

The Z370 AORUS Ultra Gaming is one of the more affordable models (\$169.99) in the AORUS Z370 lineup,

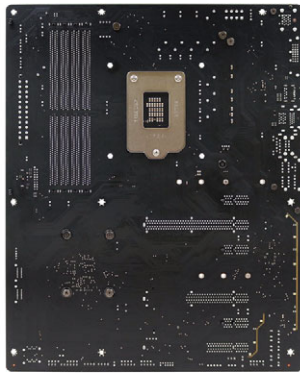
but it's not lacking much from the more expensive boards. The higher-end options, such as the Gaming 5 and Gaming 7, do include three M.2 ports, while the Z370 AORUS Ultra Gaming features two M.2 slots. The top slot supports 2242/2260/2280/22110 and slot 2 supports 2242/2260/2280. The Z370 AORUS Ultra Gaming does allow you to create a RAID 0 or 1 configuration with PCIe SSDs.

GIGABYTE takes advantage of Intel's new overclocking headroom with a speedy Turbo Boost frequency table. Our sample runs the F5 BIOS (newest as of press time), which featured the following Turbo Boost 2.0 speeds: 1 core: 4.7GHz, 2 cores: 4.6GHz, 3 cores: 4.5GHz, 4 and 5 cores: 4.4GHz, 6 cores: 4.3GHz. As such, all cores on Intel's Core i7-8700K would automatically jump to at least 4.3GHz when under load—assuming the chip is under power, temperature, and TDP specification limits.

Intel's 8th Generation processors, similar to previous generation Kaby Lake and Skylake processors, provide 16 PCIe 3.0 lanes for graphics. Multi-GPU support on the Z370 AORUS Ultra Gaming maxes out at 2-way SLI and 3-way CrossFire. The board features three PCIe 3.0 x16 slots with the top slot wired at x16, the second slot at x8, and the bottom slot at x4. Two-way SLI and CrossFire setups should be installed in the top two PCIe x16 slots and will operate at x8/x8 speed. GIGABYTE also provides three PCIe 3.0 x1 slots, which share bandwidth with the bottom PCIe x16 (wired at x4) slot.

Overclocked memory support at launch has been a bit of an adventure recently, mostly on AMD platforms, but motherboard makers appear to have a solid handle with Z370. GIGABYTE comes out of the gate supporting DDR4 modules up to 4,000MHz, and you can install up to 64GB of system memory

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT



into the board's four DIMM slots. At stock, Intel's new Core i7 and Core i5 desktop processors support DDR4 at 2666MHz, while Core i3 processors support non-OC memory at 2400MHz.

GIGABYTE was ahead of the game with RGB LEDs on its motherboards, and the AORUS lineup continues to advance mainboard visual aesthetics. The Z370 AORUS Ultra Gaming boasts LEDs between the DIMM slots, on the top two PCIe x16 slots, under the VRM and PCH heatsinks, and along the edges of the PCB. To sync with third-party RGB devices, the mainboard has two 12V RGBW LED strip headers and two D_LED (digital LED) strip headers (can be 12V or 5V). Next to the D_LED ports, there's a jumper that allows you to configure the digital header for 5V or 12V operation. GIGABYTE's RGB Fusion utility is how you'll sync the RGB lighting for components connected to the headers.

The X370 AORUS Ultra Gaming boasts Smart Fan 5 technology to let you customize fan speed curves, based on a given temperature sensor on the mainboard. There are six temperature sensors, including one under the VRM, one for the CPU socket, and one under

the top PCIe x16 slot. One new feature of Smart Fan 5 is the ability to completely turn off a fan, assuming the temperature sensor you've set stays under specified thermal limits. Making your computer quiet during idle has never been so easy.

We installed Intel's new Core i7-8700K and EVGA's GeForce GTX 1080 Ti FTW3 GAMING, among other high-end hardware, to show off the potential of the X370 AORUS Ultra Gaming. The 8th Generation flagship did well in Cinebench 15 (score of 1420) and POV-Ray 3.7 (3000 Mpixels per second). At a resolution of 2,560 x 1,440 and all settings cranked to the max, our test system delivered nearly 100fps in all our game tests, with Witcher 3 barely missing the mark at 98fps.

The Z370 AORUS Ultra Gaming fits squarely into the mid-range category, and it largely succeeds as a mid-range mainboard with some power user customization. Performance enthusiasts should like the improvements GIGABYTE made to CPU power delivery for faster, more reliable overlocks. ■

BY NATHAN LAKE

Specs: Max memory: 64GB DDR4 (DDR4-2666; Max OC: DDR4-4000); Slots: 3 PCIe 3.0 x16, 3 PCIe x1; Storage: 2 M.2 (slot 1 supports 2242/2260/2280/22110, slot 2 supports 2242/2260/2280), 6 6Gbps SATA; Rear I/O: 1 HDMI, 1 DVI-D, 2 USB 3.1 (1 Type-C, 1 Type-A), 4 USB 3.0, 2 USB 2.0, 1 PS/2, 1 Ethernet, 1 S/PDIF, audio I/O; Form factor: ATX; Warranty: 3 years

Test System Specs: Processor: Intel Core i7-8700K; GPU: EVGA GeForce GTX 1080 Ti FTW3 GAMING; Memory: Corsair Vengeance LPX 16GB DDR4-3000MHz; Storage: XPG 256GB GAMMIX S10; OS: Windows 10 Enterprise

Benchmark Results	GIGABYTE Z370 AORUS Ultra Gaming
3DMark Fire Strike	13307
Graphics Score	14116
Physics Score	19305
PCMark 10	5980
Essentials	9019
Productivity	7768
Digital Content Creation	8285
SiSoftware Sandra 2017	
Dhrystone AVX2 (GIPS)	243.75
Whetstone AVX (GFLOPS)	174.69
Multi-Media Integer AVX2 x32 (Mpixels/s)	856.75
Multi-Media Long-int AVX2 x16 (Mpixels/s)	306.9
Multi-Media Quad ALU x1 (Mpixels/s)	5
Floating B/F AVX/128 (GBps, mem bandwidth)	29.6
CrystalDiskMark 5.2.2 (MBps)	
Sequential Read (Q32T1)	1381
Sequential Write (Q32T1)	826
Random 4K Read (Q32T1)	274
Random 4K Write (Q32T1)	600
POV-Ray 3.7 (Pixels/s)	3000
Cinebench 15 (Points)	1420
Games	(2,560 x 1,440)
Metro: Last Light (Very High, 16xAF; SSAA off)	123fps
Sniper Elite 4 (VSync off, Ultra, DX12)	148fps
Witcher 3: Wild Hunt (Vsync Off, Unl. FPS, Ultra)	98fps

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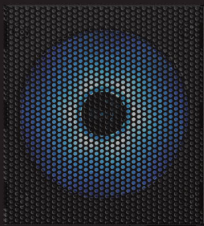
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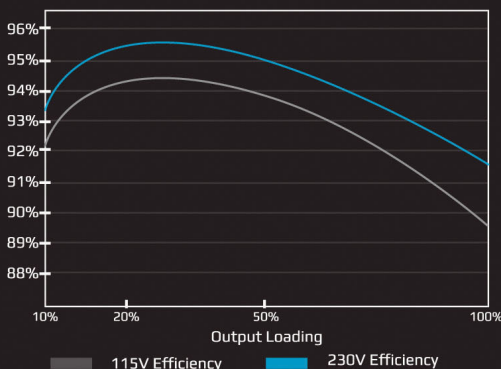
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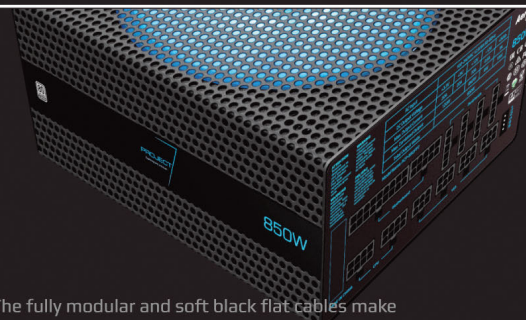
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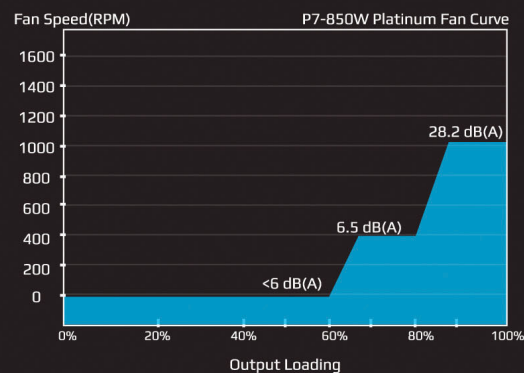
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CORSAIR LL120 RGB Fans

We know, it's late 2017, and you'd have thought we'd reached peak RGB by now, but the ever-vigilant engineers at CORSAIR have found a new nook in which to stuff LEDs. Technically, the new LL Series RGB fans are lit around the perimeter of the fan with 12 LEDs like CORSAIR's HD Series fans and hub-lit with a series of four LEDs, like the SP Series fans. These 16 LEDs are individually addressable, which means they're capable of filling your case with a number of flamboyant synchronized lighting effects.

CORSAIR sent us the 120mm three pack, which also ships with the company's Lighting Node PRO, a controller that lets you use CORSAIR Link software to manage not just the fan speeds and curves, but also your lighting in ways that you simply can't with most RGB-capable fans. The Lighting Node PRO has a spare input, which lets you expand your lighting system to include a series of CORSAIR's

individually addressable LED lighting strips, to really liven up your case interior.

The LL Series consists of 120mm and 140mm high-static pressure fans, which means they're optimized for use on heatsinks, radiators, and in other airflow-restricted environments more so than for use as open intake or exhaust fans. But that's not to say they won't work just fine in the latter scenario. The LL Series are four-pin PWM controlled hydraulic-bearing fans that are designed to run quietly even at higher RPMs. The minimum speed is 600RPMs, and at peak the fans will rotate at 1,500RPMs. CORSAIR backs the LL Series fans with a 2-year limited warranty.

Installing this series of three fans in your system involves significantly more wire management than you're probably expecting. Each LL120 fan features a traditional 4-pin fan connector that you can pair with a motherboard fan header or fan speed controller, and a four-pin

LED connector, which you'll need to connect to the LED hub. This controller features numbered ports for ensuring that the lighting effects transition smoothly between adjacent fans, and it requires a SATA power connector. This is where things get a little tangled; the LED hub then connects to the Lighting Node PRO, which relies on a SATA power connector and a USB header from your motherboard for communicating with CORSAIR Link.

Once we took the time to sort the nest of thin wires snaking haphazardly around the—hopefully—unseen areas of our enclosure, the resulting lighting effects were very eye-catching. The only real drawback we see is that CORSAIR's LL Series fans draw so much attention to the interior of our case that we suddenly feel compelled to upgrade our less-than-photogenic yet perfectly functional components. Damn these eyes. ■

BY ANDREW LEIBMAN

Specs: (LL120 Series): Dimensions: 120 x 120 x 25mm; Type: Static Pressure; Speed: 600RPM to 1,500RPM; Airflow: 43.25cfm; Air Pressure: 1.61mm H2O; Noise: 24.8dBA (at 13.2V); Connector: 4-pin; Colors: 16.8 million RGB LEDs, black frame, and white translucent blades and outer ring.

**Platimax D.F. 1200W**

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ENERMAX Platimax D.F. 1200W

Kilowatt-plus power supplies tend to be long, which can restrict your options with small form factor chassis. Long power supplies can potentially create other issues in mid-size cases. For example, the PSU might cover up routing holes in the motherboard tray or prevent you from mounting a liquid-cooling reservoir or radiator in the bottom of the case. ENERMAX's new Platimax D.F. 1200W is a mere 7-inches long (including cable bend; 6.3-inches without cables), ideal for systems short on PSU space that require plenty of juice. ENERMAX also infuses the PSU with its latest advancements, including individually sleeved cables, a self-cleaning fan mode, and semi-fanless operation.

The Platimax D.F. 1200W isn't as power efficient as ENERMAX's 80 PLUS Titanium-certified MaxTytan 800W we reviewed last month, but the unit still makes good use of the power coming from the wall. 80 PLUS testing reports that the Platimax D.F. 1200W was 89.3% efficient at 10% load, 92.74% efficient at 20% load, 92.82% at 50% load, and 89.8% efficient at 100% load.

If 1200 watts is more than you'll need, ENERMAX also offers the Platimax D.F. in 750W, 850W, and 1050W power capacities.

The 1200W model is designed with four +12V rails, and ENERMAX includes a one-page sheet that illustrates where you should install the respective main (20+4-pin), CPU, and GPU power cables. Two of the rails support up 25A each—with 12V1 dedicated to the 20+4-pin connector and 12V2 serving up CPU power. The remaining two +12V rails are a bit more versatile—with multiple power outputs—and support 40A each. 12V3 supports a second CPU connector, a PCIe connector, and all the SATA and Molex connectors. 12V4 features two PCIe outputs and is meant to be the primary source for GPU power.

It's no surprise these days to see a completely modular PSU, but like the MaxTytan 800W, we like that ENERMAX opts for individually sleeved cables with an attractive black and white aesthetic. The available connections are what you'd assume for a 1200 watt power supply. A complete list of the connectors

is in the specifications section of this review. All of the cables are long enough to route the wiring—striking as it is—behind the motherboard tray. Cable combs are provided to dress up the wiring where it is visible.

We tested the Platimax D.F. 1200W on the same X399 system we used to torture the MaxTytan 800W, and the Platimax put up surprisingly similar results. Prime95's In-place test puts an extreme load on our Ryzen Threadripper 1950X, and we simultaneously run Unigine's SuperPosition on two GeForce GTX 1080 Ti's in SLI to draw graphics power. Under this load, the Platimax D.F. averaged 500 watts with a quality power factor between .989 and .997.

The Platimax D.F. series boast a number of worthwhile upgrades over ENERMAX's existing Platimax lineup. The power supply's pricing (\$269.99) is also in line with other premium, kilowatt-plus power supplies on the market, and the new Platimax design makes it one of the top high wattage models available. ■

BY NATHAN LAKE

Specs: Maximum wattage (continuous): 1200W @ 50 C; +12V rails: 2 25A, 2 40A; +5V max: 25A; +3.3V max: 25A; Efficiency rating (advertised): 80 PLUS Platinum; Fan: 139mm; Connectors: 1 x 20+4-pin ATX, 1 x 4+4-pin EPS12V (CPU), 1 8-pin EPS12V (CPU), 6 x 6+2-pin PCIe (GPU), 12 x SATA, 4 x Molex, 1 Floppy (adapter); Warranty: 5 years

Test System Specs: Processor: AMD Ryzen Threadripper 1950X; Motherboard: AORUS X399 Gaming 7; GPU: NVIDIA GeForce GTX 1080 Ti (x2, SLI); Memory: HyperX Predator DDR4-3000; Storage: 480GB Patriot Hellfire; OS: Windows 10 Enterprise

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Aerocool P7-850W Platinum

Aerocool continues to expand the hardware within its P7 (Project 7) lineup. The cooling experts kicked off P7 last October with the P7-C1 case and Aerocool added a P7-C0 model this May. Both chassis feature LED accent rings in the front panel, among other premium amenities. In July, Aerocool released its P7-F12 RGB fans, as well as a hub (the P7-H1) where you could connect the RGB fans, should your motherboard lack an RGB 4-pin header. The P7-850W Platinum is an extremely efficient power supply that also boasts a 140mm RGB fan.

RGB lighting is probably the most distinctive feature of P7-850W Platinum, but there's plenty to like about what's underneath the fan. Aerocool avoids cable connections between the PSU's separate power handling components, opting instead to route power over daughterboards and the main PCB. The design, according to Aerocool, improves reliability and airflow, and reduces PSU noise. The 140mm RGB fan only spins up at 60% load (510 watts) and even then, the fan only rotates at 500rpm. If loads go above 80%, Aerocool engineers the fan to further pick up the pace, so it's likely you'll only hear the PSU under extreme loads.

Power supplies are typically most efficient at 50% load, but the 80 PLUS' testing report shows that the P7-850W Platinum was most efficient (94.08% efficiency) at 20% load and "dropped"

to 92.76% efficient at 50% load. PSU efficiency levels above 90% are considered excellent, and the P7-850W Platinum is close to the 80 PLUS Titanium standards. The quality efficiency at lower loads also means this PSU will operate efficiently even when you're not gaming or pushing the system with demanding tasks.

The 140mm RGB fan inside the PSU will light up when you connect the included 4-pin RGB cable to a motherboard's RGB header. You can control the color and lighting effects with the motherboard's RGB software utility. Aerocool knows RGB headers on mainboards are a relatively new feature, so they also allow the PSU to work with its P7-H1 fan hub—it's sold separately and costs \$25.

Aerocool sufficiently covers the connectivity we'd expect from an 850 watt power supply. There are two CPU power cables; one with an 8-pin connector and one with a 4+4-pin connector. To deliver juice to your GPUs, there are six PCIe 6+2-pin connectors split among four cables—two cables with two 6+2-pin connectors and two cables with a single 6+2-pin connector. Other system hardware is covered by 10 SATA and six Molex connectors.

The P7 850W Platinum's rail distribution is a single +12V system, where up to 70A (840 watts) is available to the +12V rail. The +5V and +3.3V rails both support up to 20A and a maximum combined wattage of 120W. Aerocool

protects your system hardware and the PSU against overvoltage, undervoltage, overcurrent, overtemperature, and overpower conditions. Aerocool also covers the P7-850W Platinum with a seven-year warranty, a big increase from previous Aerocool models we've tested that featured two-year warranties.

Platinum-level power supplies generally perform well in our testing, and the same is true for Aerocool's P7-850W. Our test bench includes an AMD Ryzen Threadripper 1950X and two NVIDIA GeForce GTX 1080 Ti GPUs in SLI. We stress tested the PSU by simultaneously running Prime95 on the 1950X's 32 threads, while Unigine's Superposition benchmark (run at 8K) drives the GPU workload. During benchmarking, average wattage was 540 watts with a maximum power factor of .991. Power factor was routinely between .980 and .992 during testing.

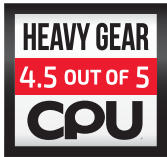
We like the innovations Aerocool adds, and continues to deliver, with its P7 series. The P7-850W Platinum, in particular, is well designed and aesthetically pleasing. The former is important, as we know that RGB enthusiasts also require a power supply that will provide reliable juice to system components. We also like that Aerocool engineers the PSU to be efficient at lower power levels to let you enjoy power efficient operation at all times. ■

BY NATHAN LAKE

Specs: Maximum wattage (continuous): 850W @ 50 C; +12V rail: 1 70A; +5V max: 20A; +3.3V max: 20A; Efficiency rating (advertised): 80 PLUS Platinum; Fan: 140mm; Connectors: 1 x 20+4-pin ATX, 1 x 4+4-pin EPS12V (CPU), 1 8-pin EPS12V (CPU), 6 x 6+2-pin PCIe (GPU), 10 x SATA, 6 x Molex, 1 Floppy (adapter), 1 RGB 4-pin; Warranty: 7 years

Test System Specs: Processor: AMD Ryzen Threadripper 1950X; Motherboard: GIGABYTE X399 DESIGNARE EX; GPU: NVIDIA GeForce GTX 1080 Ti (x2, SLI); Memory: HyperX Predator DDR4-3000; Storage: 480GB Patriot Hellfire; OS: Windows 10 Enterprise

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT

**LIQTECH TR4 240**

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ENERMAX LIQTECH TR4 240

AMD's Ryzen Threadripper processors are, physically, the biggest consumer processors in recent memory. The mammoth CPU is 72mm by 55mm and slides into an even bigger TR4 motherboard socket. Several CPU cooler manufacturers have designed new mounting brackets to allow existing high-end AIO coolers and CPU waterblocks to support Threadripper. But just bolting a new mount onto the CPU block doesn't mean that the cold plate will cover the entire CPU. In many cases, the block is big enough to cover the processor die, but not Threadripper's entire IHS (Integrated Heat Spreader). The LIQTECH TR4 240 is designed specifically for Threadripper with a huge copper cold plate that covers 100% of the IHS.

A quality CPU cooler can be a big boost to Ryzen Threadripper and other Ryzen processors ending in "X." AMD uses its XFR (Extended Frequency Range) technology to reward systems with excellent cooling with automatic boosts to CPU core clocks. ENERMAX's LIQTECH TR4 boasts an outstanding 500 watt TDP to enable significant Threadripper overlocks. ENERMAX also

includes a powerful pump that's rated for 450 liters per hour.

The pump's consistent flow rate works in conjunction with ENERMAX's Shunt-Channel Technology to break up liquid boundary layers that slow the flow of coolant across the cold plate. In short, Shunt-Channel Technology helps to prevent hot spots and thermal throttling. The coolant inside the closed-loop passes through rubber tubes with braided sleeves that give the CPU cooler a premium look.

ENERMAX makes two versions of the LIQTECH TR4, one with a 240mm radiator (our test unit) and one with a 360mm radiator. The LIQTECH TR4 240 kit comes with two high static pressure fans rated for up to 6.28mm/H₂O when the fans run at peak speed (2,300rpm). Even at full tilt, the two Twister Bearing series fans are fairly unobtrusive with a maximum noise level of 28dB(A). The included fans also feature a 500rpm minimum PWM range for quiet operation (14dB[A]) during idle. ENERMAX adds anti-vibration rubber pads, as well as a thin strip of rubber on the radiator, to eliminate vibration noise.

To test out the LIQTECH TR4 240, we installed it onto a system with AMD's Ryzen Threadripper 1950X and GIGABYTE's AORUS X399 Gaming 7. We used HWINFO to monitor temps, and the utility lists both the Threadripper T(die), which is the interface between the die and heat spreader, and T(CTL), an offset temperature to help the CPU ensure a consistent fan speed. For our purposes, the T(die) temperature is the most important. Running POV-Ray 3.7 on all the 1950X's cores and threads pushed average temps to 50 degrees Celsius—with a max of 55 C. In Prime 95, temperatures averaged 52.1 C with a maximum heat of 56 C.

Our testing shows that the LIQTECH TR4 provides plenty of headroom for overclocking your Ryzen Threadripper. We also like that the kit is custom-made for the TR4 socket and Threadripper. ENERMAX has designed a closed-loop CPU cooler that stands out from the crowd and also serves the interests of performance enthusiasts. ■

BY NATHAN LAKE

Specs: Materials: copper (waterblock) and aluminum (radiator); Socket compatibility: AMD TR4/SP3; Pump: 12V (3,000rpm motor speed); Fans: 2 120mm (500 to 2,300rpm); 1.5 x 10.8 x 4.7 inches (HxWxD); Warranty: 2 years

Test System Specs: Processor: AMD Ryzen Threadripper 1950X; Motherboard: GIGABYTE AORUS X399 Gaming 7; GPU: GIGABYTE AORUS GeForce GTX 1080 Ti 11G; Memory: 32GB HyperX Predator DDR4-3000; Storage: 480GB Patriot Hellfire; OS: Windows 10 Enterprise

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT

RIG

OF THE MONTH

HEAVY GEAR
4.0 OUT OF 5
CPU

Threadripper Extreme Gaming PC By AVADirect



Threadripper Extreme Gaming PC

\$5,506.88 as tested

AVADirect

www.avadirect.com

CPU's "Rig Of The Month" feature has showcased systems with Intel processors several months in a row, so we asked AVADirect to provide us with a lean, mean AMD Threadripper machine. Past rigs, including AVADirect's Z270 Scorpio, were also heavy on custom liquid-cooling loops with rigid tubing and creative paint jobs. And while these

builds were visually astounding, the complex and time-consuming craftsmanship often pushed system cost north of \$9,000. AVADirect's challenge, then, was to create an incredibly powerful and attractive Threadripper system without going overboard on the eye candy. We consider the resulting Threadripper Extreme Gaming PC by AVADirect a resounding success.

So Many Cores

Most people probably won't call a PC that costs \$5,506 a bargain, but by Rig Of The Month standards, the Threadripper Extreme Gaming PC is relatively inexpensive. Anything with "extreme" in the title, after all, still better include the best hardware available. AMD's Ryzen Threadripper 1950X is the CPU of choice, and it's ready for work and play with 16 cores and SMT (Simultaneous Multithreading) enabled to multitask with 32 threads. AVADirect cools the 1950X with Corsair's Hydro Series H115i—an AIO closed-loop CPU cooler with a 280mm radiator—designed to support high-powered processors.

When gaming, this rig has plenty of CUDA cores to go around. AVADirect installs two MSI GeForce GTX 1080 Ti



MSI's GeForce GTX 1080 Ti DUKE 11G OC GPUs provide a combined 7,168 CUDA cores for excellent gaming frame rates.

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT

DUKE 11G OC graphics cards that each boast 3,584 CUDA cores. This noble SLI setup also features great factory overclocks. The base clock is 1,531MHz (51MHz over the Founder's Edition) and boost clock is 1,645MHz (63Mhz above the Founder's Edition). MSI's TRI-FROZER cooling helps to keep each GPU cool, and 8mm heatpipes in the heatsink efficiently transfer heat away from the GPU die.

No Lost Threads

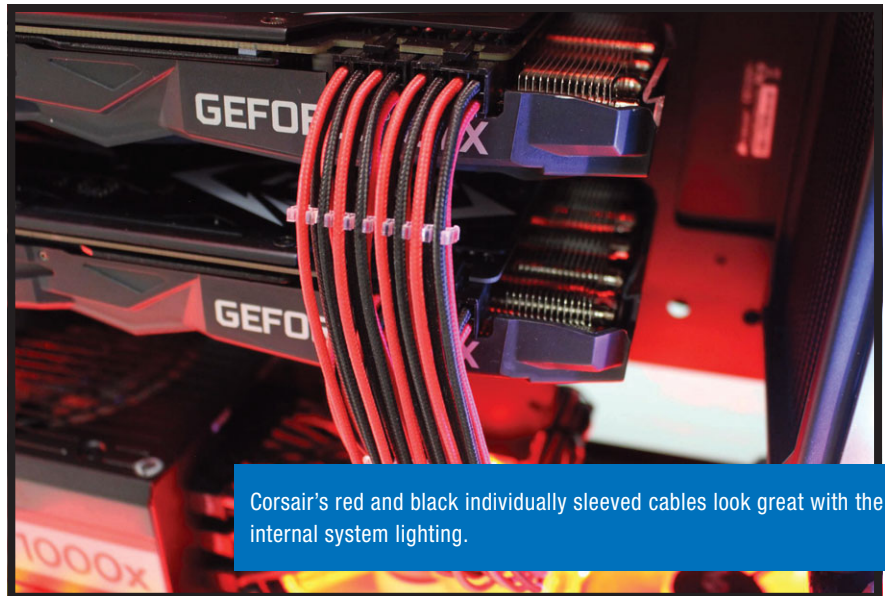
AVADirect surrounds the CPU and GPUs with high-quality components that keep the system snappy and responsive. There are four 8GB sticks of HyperX Predator DDR4-3000 memory to optimize memory bandwidth on Threadripper's quad-channel memory controller. The 32GB total capacity should be enough for all but the most demanding power users. ASUS' ROG Strix X399-E Gaming sits at the heart of the Threadripper Extreme Gaming PC, and this motherboard is ready for the uber-powerful 1950X. ASUS connects a miniature radiator to the VRMs, which are actively cooled by a tiny fan in the rear I/O.

To prevent thermal throttling on M.2 drives, one of the M.2 slots on the ROG Strix X399-E Gaming features a heat shield. That's where AVADirect installs the Samsung SSD 960 EVO in this build, and the PCIe SSD serves as the OS drive. Mass file storage is covered by a 1TB Samsung SSD 850 EVO, one of the largest-capacity SATA SSDs available. The whole system is powered by CORSAIR's RM1000X.

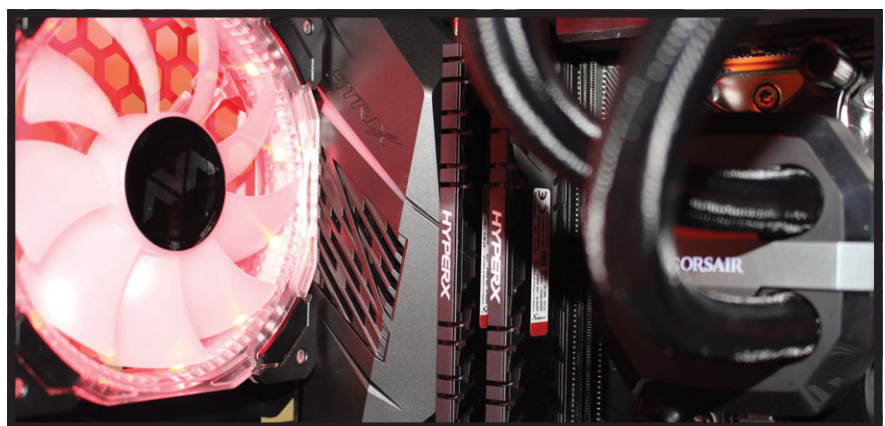
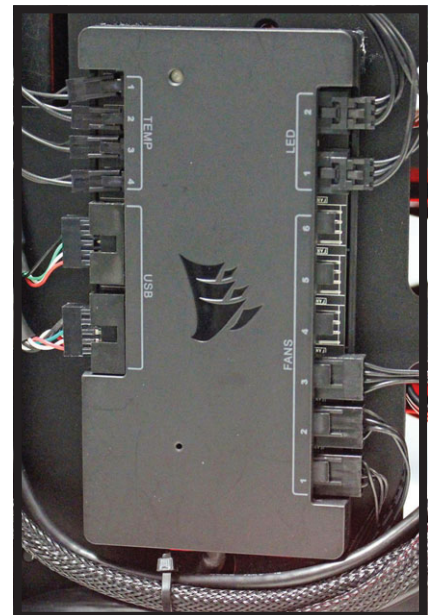
View From All Angles

Just because we asked AVADirect to stay away from costly visual additions doesn't mean the builder threw aesthetics out the window. AVADirect's chassis of choice, the In Win 805 Red, is almost completely covered with tempered-glass panels, so you can see the internal components and the case's skeletal structure. In the few areas where the exterior isn't glass (the top panel and front I/O ports), the 805 Red features a high-quality brushed-aluminum finish. The strip of red brushed aluminum along the I/O panel is a particularly nice accent.

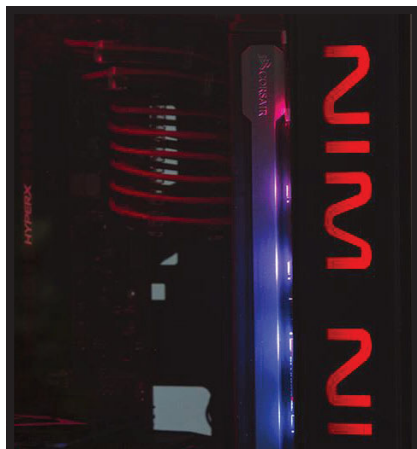
AVADirect doesn't take full advantage of, arguably, the 805's most interesting visual



Corsair's red and black individually sleeved cables look great with the internal system lighting.



CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT



LEDs near the IN WIN logo trail each other up and down the LED strip.

addition—the honeycomb pattern behind the front glass panel. When backlit, LED lighting will outline the honeycomb structure along the entire front panel. But the two 140mm fans cooling 280mm radiator don't have LEDs, and the radiator blocks light from other LEDs inside the case.

The inside of the case is well lit, thanks to three CORSAIR HD120 RGB fans and a few CORSAIR LED light strips. The interior CORSAIR fans and LED strips all connect to CORSAIR's Commander PRO to let us adjust LED colors and effects, as well as fan speed. The builder opted for an all-red motif—except for the LED strip near the front panel that runs in CORSAIR's Visor mode where the four LEDs follow each other up and down the strip. LEDs are also present on the ASUS ROG Strix X399-E Gaming and two MSI GeForce GTX 1080 Ti DUKE 11G OC graphics cards. You'll need to open the respective utilities to manage the LEDs.

Where Detail Matters

AVADirect has always done an excellent wiring job in the past, but using the In Win 805 Red really put the builder to the test. There's nowhere to hide the cabling

behind the motherboard tray because of the tempered-glass side panel. To improve the look—both in front of and behind the motherboard—AVADirect opted to supplement the existing power cables with red and black individually sleeved cables. Cable combs are liberally applied to create straight runs of wiring that gently arch where they need to go. On the backside of the motherboard tray, the builder creates a single line of wiring that's tied in place. It's a tidy cabling job that shows AVADirect knows what they're doing.

Benchmark Ripper

Focusing this build around premium hardware paid off handsomely in our benchmark testing, as the results were similar to previous Rig Of The Month builds—despite being a few thousand dollars cheaper. The AMD Ryzen Threadripper 1950X shone in POV-Ray 3.7 (5,800 pixels per second) and Cinebench 15 (3,029 points). The set of MSI GeForce GTX 1080 Ti DUKE 11G OC cards delivered around 100fps in our game tests at 4K, while frame rates in the same games at 2,560 x 1,440 were between 144 and 165fps. The Samsung SSD 960 EVO was impressive, as well, with a sequential read speed of 3,245MBps and a write speed of 1,706MBps in CrystalDiskMark 5.22.

Just Enough Ornamentation

The Threadripper Extreme Gaming PC by AVADirect is a good example of how an expert builder can both maximize performance and visually spice up a system without a complex, expensive custom liquid-cooling loop. AVADirect's enthusiast hardware choices supplied us with a system that's as adept at content creation as it is with gaming. And the attractive case, fan, and wiring amenities allow AVADirect to produce a great-looking system within a (relative) budget. ■

BY NATHAN LAKE

Specs:

Processor: AMD Ryzen Threadripper 1950X; Motherboard: ASUS ROG Strix X399-E Gaming; GPU: MSI GeForce GTX 1080 Ti DUKE 11G OC (x2, SLI); Memory: 32GB HyperX Predator DDR4-3000; Storage: 512GB Samsung SSD 960 EVO, 1TB Samsung SSD 850 EVO; PSU: Corsair RM1000x; OS: Windows 10 Home

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT

Benchmark Results	Threadripper Extreme Gaming PC
3DMark Fire Strike Extreme	
Overall Score	21561
Graphics Score	25572
Physics Score	24719
PCMark 10	
Score	5086
Essentials	7453
Productivity	5785
Digital Content Creation	8282
SiSoftware Sandra Platinum SP2	
Dhrystone AVX2 (GIPS)	472.49
Whetstone AVX (GFLOPS)	220.16
Multi-media Integer AVX2 x32 (Mpixels/s)	951
Multi-media Long-int AVX2 x16 (Mpixels/s)	282.7
Multi-media Quad-ALU x1 (Mpixels/s)	10.73
Floating B/F AVX/128 (GBps, mem bandwidth)	56.3
CrystalDiskMark 5.22 (MBps)	
Sequential Read (Q32T1)	3245
Sequential Write (Q32T1)	1706
Random 4K Read (Q32T1)	357.7
Random 4K Write (Q32T1)	318.7
POV-Ray 3.7 (Pixels/s)	5800
Cinebench 15 (Points)	3029
Games	2,560 x 1,440
Metro: Last Light (Very High, 16xAF; SSAA off)	165fps
Sniper Elite 4 (VSync off, Ultra, DX12, SLI not supported)	144fps
Witcher 3: Wild Hunt (Vsync Off, Unl. FPS, Ultra)	151fps
Games	3,840 x 2,160
Metro: Last Light (Very High, 16xAF; SSAA off)	99fps
Sniper Elite 4 (VSync off, Ultra, DX12, SLI not supported)	107fps
Witcher 3: Wild Hunt (Vsync Off, Unl. FPS, Ultra)	91fps

Endless Possibilities Unbeatable Modularity



DARK BASE 900

There may be countless ways to build a PC. But there's one series of PC cases that makes them all possible: Dark Base 900. It offers maximum flexibility to suit your individual space requirements. And of course, it's one of the quietest cases in the world, featuring:

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Verktøy Cu

Readers who watch this space won't be surprised that we're featuring a steampunk-themed mod; it's hardly the first. What we didn't know when Derick "Senpai Studios" Magnusen submitted this month's Mad Reader Mod, Verktøy Cu, via the *CPU* website was that he was inspired to build this magnificent mod several years ago when he saw another Mad Reader Mod winner, Shane Fuga's Steampunk'd TJ11. Steampunk'd graced the cover of our May 2013 issue, and to this day is one of our all-time favorites.

"From that moment, I knew I wanted to do a steampunk build," Magnusen says. "The opportunity to do one never came up, however, until 2016 when I first started this build. What's exciting about steampunk is that there are lots of different art styles; you don't have to necessarily use a bunch of copper, brass, or cogs to do a steampunk build. The particular art style of this build was inspired by a guy named Ian Finch Field, who has an Etsy shop named SkinzNhydez (www.etsy.com/people/SkinzNhydez). I had always appreciated the work he was able to do with layering brass with leather, and not many people in the modding industry use leather, so it seemed like a good way to make the build stand out."

The mod's distinctive name, roughly translated is "copper tool." "I often choose my PC names either from cat species if one fits appropriately, or I try to find some 'interesting' words via Google Translate," Magnusen says. "In this case,

I decided to with verktøy, the rough Norwegian translation of 'work tool,' due to my Norwegian background and because the system will primarily be used for work. From there, I added 'Cu' due to the large amount of copper I planned to use in the build." ["Cu" is copper's symbol on the periodic table.]

I De Verksted

Magnusen, who says he spent upwards of 200 hours working on Verktøy Cu over the course of about a year and a half, does all of his modding in a spare bedroom and bathroom in his apartment. "I have a small paint booth set up in the shower, and all of the power tools are used on a makeshift table that's situated above the toilet," he says. "I try to do all the modding that makes a mess in the bathroom so it can be relatively contained. Assembly, modding such as sleeving, and photography and video work I do in the spare bedroom that the bathroom is attached to."

In the process of creating Verktøy Cu, Magnusen says he used a few fairly interesting materials, leather and copper leaf foremost among them. "Leatherworking is really tough and really complex, but working with it was really satisfying," he says. "Copper leaf is a really simple material that I can't believe I've never heard about in the past. It's basically a cheaper and easier way to copper-plate something. It's not quite the same, of course, as the finish won't be nearly as pristine, but proper copper plating



HARD HAT AREA

PC MODDER

MAD READER MOD

isn't something many modders have access to, so it works. The other advantage is that you can apply it to anything, not just metals."

Magnusen used copper leaf on the rig's power supply, motherboard tray, fan grilles, and mounting clamps. Some parts of Verktøy Cu (CPU waterblocks, GPU backplates, GPU I/O shields, RAM waterblocks, and SSD waterblocks) did get proper copper plating, as Magnusen worked for a manufacturer at the time who could provide that service. Magnusen sanded each of the more than 200 fittings down to bare brass or painted them, he painted every screw in the system, and he of course painted the case. He used brass leaf on the reservoir, and he cut, shaped, and dyed all of the leather by hand. He then cut the brass panels on top of the leather out of a single sheet of brass; he drilled all of the many rivet holes by hand and set the rivets, took apart all 15 case fans and painted them, and did all of the custom copper pipe work, as well as some PETG tubing work.

"The two gauges on the side were added in and controlled via Arduino (hooked up via internal USB 2.0) to display real-time CPU and RAM usage," Magnusen says.

And there's more; Magnusen did a ton of work on this rig, and it clearly shows.

Datamaskin Deler

In addition to scads of copper, leather, brass, and other cool stuff, Verktøy Cu consists of twin Intel Xeon E5-

2687W V4 processors (this is a workstation, after all), an ASUS Z10PE-D8 WS motherboard, 128GB of ECC DDR4-2400 memory, four NVIDIA GTX TITAN Xp graphics cards, a Corsair AX1500i power supply, and four Intel SSD 750 Series 1.2TB NVMe drives.

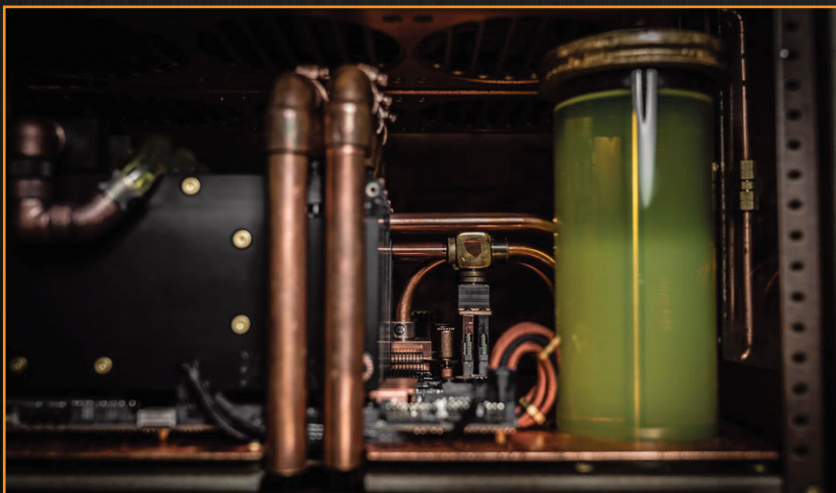
The foundation for the build is a CaseLabs S8, and the cooling system is largely custom but also uses EK waterblocks. Magnusen says Mnpctech fan grilles and custom case feet rounded out the parts list.

Magnusen is very busy and has already finished another mod (this one a wood-themed build) since finishing Verktøy Cu, and says that he's currently building 32 high-end systems for a client.

"I learned from this build that in order to get things done, you need to put yourself out there and start working on it," Magnusen says. "I spent way too much time just planning things out for this build, and almost everything eventually changed as I was building it anyway. If you're unsure of how to do a technique or use a new tool, the best way to learn is to just start doing it and learn as you go. If you spend too much time thinking about it, then the build takes a year and a half like this one did." ■



HARD HAT AREA
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Aerocool Project 7

P7-850W Platinum

Bright Lights, Big Power

For hardware manufacturers, balancing between innovation and conformity is often a tightrope act with a razor-thin margin of error. Enthusiasts are always hungry for original components, those that unlock untold levels of performance, simplify or solve problems in a unique way, or just give us something new to look at. However, innovation doesn't guarantee success, and if a company's creative new component doesn't catch on with power users (who demand results, not just originality for originality's sake), that company probably just flushed a lot of R&D cash right down the drain. Make this mistake a couple of times, and you've innovated yourself into Chapter 11.

Another approach is to play follow the leader. Once a breakout component or technology establishes itself as battle-tested and enthusiast-approved, in short order a tidal wave of similar hardware crashes down into the market; when companies see a proven demand for a new type of hardware or a fresh approach on an existing part, they'll quickly put together their own take on the component in question. On one hand, the wait-and-see strategy eliminates the risk of the unknown. On the other hand, creating we-too hardware has risks, as well, such as getting lost in the crowd of copycat components. What's a manufacturer to do?

Aerocool has decided to walk both paths with one of its latest ventures, the Project 7 family of power supplies. Hoping to capitalize on the recent explosion of LED hardware, Project 7 PSUs include an LED fan and a new twist: These 80 PLUS Platinum-certified



Aerocool's Project 7 PSUs, including the P7-850W Platinum, have the modern sensibilities we look for in our components. Although incorporating an LED fan into a power supply isn't strictly a new innovation, Aerocool has built a trio of PSUs that are equipped to work with cutting-edge LED hardware that is currently wildly popular with power users.

power plants come equipped with an RGB LED header, making it easy to incorporate one into your own elaborate lighting scheme.

Inside Project 7

If you know Aerocool, you know that the company has a handful of component types in its wheelhouse, namely cases, power supplies, case fans, and CPU

coolers. As an expert in these areas, the company has been able to start with a solid foundation and build compelling gear for power users interested in adding even more LEDs to their builds. Thus, Project 7 was born.

When Aerocool unveiled Project 7 at this year's Computex, its mission was to put RGB components in the hands of as many power users as

possible. “We’re delivering on the needs of the gaming community,” Aerocool CEO Tony Lin said in a late May release, “especially those seeking an affordable RGB solution. Our solution helps sync Aerocool RGB-ready products across cases, coolers, fans, PSUs, and even motherboards.”

Welcome To The Light Show

Although incorporating an LED fan inside a power supply isn’t a revolutionary new idea, Aerocool’s Project 7 P7-850W PSU (and its 650W and 750W siblings) has a 140mm fan that’s an ideal complement for high-end motherboards with RGB LED functionality or a standalone LED controller. In fact, Aerocool has produced its own LED controller, which lets other Project 7 hardware shine even when a system doesn’t have a motherboard with a 4-pin header for RGB LEDs.

Aerocool’s P7-H1 (Project7-Hub1) acts as a hub for Aerocool’s Project 7 line, as well as other RGB LED hardware that connects via a 3- or 4-pin header. In addition to a pair of 4-pin LED connectors, the P7-H1 has a battery of five 4-pin fan headers used for monitoring a PC’s case fans.

“Project 7’s Pro cases, PSUs, liquid cooling, and cooling fans can synchronize RGB,” says Michael Chen, Aerocool creative director. “If users are using a motherboard with a 4-pin RGB configuration, the Project 7 PSUs can connect directly to the RGB outlet of the motherboard. This gives PC enthusiasts full control of all the RGB.”

Once you’ve connected the P7-850W Platinum to Aerocool’s P7-H1 or a similar LED controller (or, as we’ve mentioned, one of the many motherboards from GIGABYTE, MSI, ASUS, etc. that include an RGB LED header), you’re

almost ready to turn on the lights. If you plan on staying under Aerocool’s roof, download the company’s P7-S1 (Project7-Software1) app, which Aerocool designed specifically for the P7-850W Platinum and other Project 7 components. P7-S1 unlocks all 16.8 million colors the P7-850W Platinum is capable of producing, letting you punch in RGB values or Hex codes to get precisely the color you want, matching the rest of your system’s color scheme. In addition to shining a solid color, Aerocool’s P7-S1 software can produce breathing and pulsating effects. You also have control over LED brightness and effect speed, and the software lets you keep an eye on any connected fans’ RPM (but it doesn’t let you control their speed).

Despite the cool things you can do with the P7-850W Platinum’s RGB LED capabilities, especially when you combine it with a Project 7 case, fans, and so forth, the power supply itself is no slouch. For as much style as the P7-850W Platinum has on the outside, there’s plenty of substance hiding on the inside.

Now You’re Playing With Power

In the past, flashy and shiny hardware often served as distraction to draw attention away from mediocre build quality. Don’t want ordinary consumers to notice all the places you’ve cut corners? Drape your hardware with LEDs, give it a cool name, and get it out of the factory and in front of unassuming buyers as fast as possible. Savvy enthusiasts are wise to these types of parlor tricks.

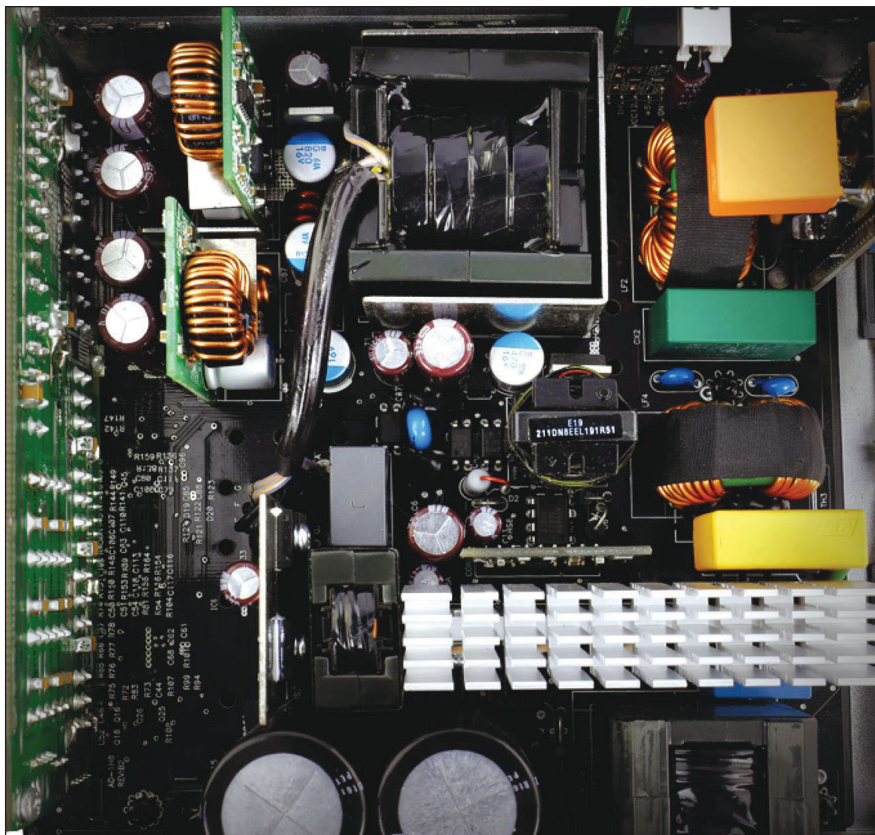
Thankfully Aerocool keeps this kind of smoke and mirrors out of its playbook. The company’s plan from the beginning with Project 7 was to build top-shelf components and then make them look good.

“Our goal for the P7-850W PSU (or any Project 7 products) is to build both high quality and market-oriented PC components,” says Chen. “The philosophy behind it is to create what’s expected in a genuine high quality and high-performance PSU.”

Chen explains that Aerocool’s engineers went all out during the P7-850W’s

LET THERE BE LIGHT . . . AND POWER

Aerocool Project 7 PSU Specs	P7-650W Platinum	P7-750W Platinum	P7-850W Platinum
Maximum wattage (continuous)	650W	750W	850W
12V rail	54A	62A	70A
5V rail	20A	20A	20A
3.3V rail	20A	20A	20A
Efficiency rating (80 PLUS)	Platinum	Platinum	Platinum
Efficiency rating (Cybenetics ETA)	B	B	B
Efficiency rating (Cybenetics LAMDA)	A++	A+	A
Fan	140mm LED	140mm LED	140mm LED
ATX connector	20+4-pin	20+4-pin	20+4-pin
12V CPU connectors	1x 8-pin, 1x 4+4-pin	1x 8-pin, 1x 4+4-pin	1x 8-pin, 1x 4+4-pin
PCIe connectors	4x 6+2-pin	6x 6+2-pin	6x 6+2-pin
SATA connectors	8	10	10
Molex connectors	6	6	6
Additional connectors	1x RGB, 1x Molex-to-FDD	1x RGB, 1x Molex-to-FDD	1x RGB, 1x Molex-to-FDD
Warranty	7 years	7 years	7 years



The P7-850W Platinum's RGB will certainly grab your attention, but the power supply is just as intriguing on the inside. Aerocool uses an Etched Circuit Design, which means the P7-850W Platinum's internal components are almost completely free of wires.

R&D phase. He tells us that the power supply went through four major revisions ("with countless minor changes with each version") before Aerocool finally arrived at the finished product. As the team worked on the P7-850W and the other Project 7 power supplies, they encountered "many obstacles" that they were initially unable to overcome, but they pressed on until they had solved every problem.

"We have made sure that the P7-850W Platinum met every goal on our list," Chen says.

Chen relates one challenge Aerocool's engineers faced as they attempted to improve the PSU's hold-up time. During internal testing, the P7-850W was unable to achieve a hold-up time of 16ms at 100% load, mostly because they didn't think the power supply had enough room internally to use a more efficient primary

capacitor. Eventually, the team devised "a unique spec of primary capacitor" that was small enough to fit inside the P7-850W and also gave them a 16ms hold-up time."

"This, of course, resulted in added cost for production," Chen explains, "but we were committed to making it happen."

The company's tenacity pursuing each and every item on its wish list has naturally given the P7-850W the advantage of boasting first-rate internals. For example, all three Project 7 PSUs feature Japanese capacitors, which can withstand quite a bit of punishment. These caps maintain their efficiency even when ambient temperatures climb to 50 degrees Celsius. According to Chen, the capacitors also have a longer life span, superior noise filtering, and more efficient energy storage.

Japanese capacitors are indeed an excellent addition, but Aerocool doesn't

maintain a stranglehold on them. However, Aerocool uses an Etched Circuit Design for all of its Project 7 power supplies. Essentially, there are virtually no wires connecting any of the P7-850W Platinum's internal components, including the daughterboards. The Etched Circuit Design confers a number of benefits. For starters, with the elimination of wires within Project 7 PSUs' housing, they have lower internal airflow resistance, which not only reduces their noise output but also extends the life span of the fan. Chen also mentions that the Etched Circuit Design circumvents any human error from connecting wires during the assembly process, which can lead to premature failures. Overall, the end result is a power supply that's quieter, more efficient, and more reliable.

A byproduct of the Etched Circuit Design is that it freed Aerocool to use an all-modular cable design for the Project 7 PSUs. The flat cables are easy to maneuver through a case, and you only have to connect the cables your components need, of course.

Functionally, at least, the P7-850W Platinum's fan joins the group of other PSU fans that only rev up when you call on all of the power supply's might. Specifically, it doesn't need to spin at all until the P7-850W reaches 60% load. Until 80% load, the fan spins at a leisurely pace, never exceeding 500rpm. After 80% load, the power supply's fan gradually speeds up according to load, eventually resulting in a maximum noise output of 28.2dB(A). The fan uses a fluid dynamic bearing, which Chen indicates is quieter than ball bearing fans and has a longer life span than sleeve bearing fans.

Bright Future

If you haven't figured it out by now, Aerocool's insistence on build quality produced three power supplies that are all 80 PLUS Platinum-certified. And according to Chen, Aerocool is all in on Project 7.

"Project 7 is Aerocool's premium product line. So far, we have PC chassis, an RGB hub, liquid cooling, cooling fans, and PSUs, and we will continue to develop and build the highest quality of products under the Project 7 family." ■

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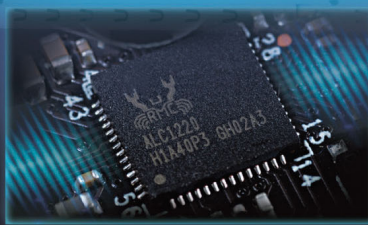
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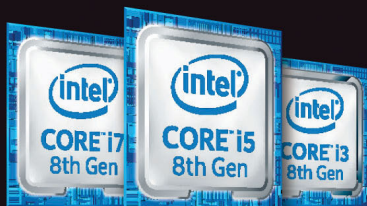


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In The Loop

A Fluid Situation

For this installment of “In The Loop,” we spoke with PrimoChill Senior Technical H2O Specialist Elliot Shiver and Alphacool’s Eddy Peters, to zero in on the particulars of liquid coolant and the many options you have for filling pipes, reservoirs, and radiators.

Q: Coolant’s job is to whisk heat from waterblocks to radiators. Isn’t plain old water good enough?

ES: Water is a good option because it’s cheap, widely available, and offers excellent thermal conductivity, high density, and low viscosity. However, it’s not a practical option because it tends to grow bacteria and algae when exposed to sunlight, ending up slimy and green. Water also facilitates corrosion and loves to deposit metal ions and minerals onto your tubing, leaving a hazy film. Water, despite appearances, is actually not very wet. Ever plunge your arm into water to find it covered in bubbles? This is water failing to wet a good portion of your skin. The same thing happens when you put pure water in your loop, and the cooling ability of it suffers.

EP: It may not look like it, but tap water is very impure. Small particles of lime can clog the cooler’s ducts, which can lead to a steep drop in cooling performance. Since tap water is often full of bacteria and microorganisms, algae and fungi can also build up in the system, often in areas that are impossible to see, such as in the radiator or directly in the angled parts of connectors. On top of that, tap water conducts electricity, while distilled water actually can’t conduct electricity at all, which helps if something leaks.

Q: Is distilled water a bad idea? What about deionized water? If



PrimoChill Ice is a low-conductive fluid that may mean the difference between a minor leak and a major overhaul.

you’re planning to use water, which type is ideal?

ES: Distilled and deionized water can make an excellent base when diluting concentrate. Tap water, on the other hand, contains minerals and additives such as chlorine that you really don’t want in your loop. Distilled water, with minimal additives such as Liquid Utopia from PrimoChill, is the better option. Most distilled water tests high for copper, which is an artifact of the distillation process, but this isn’t a problem for copper-based PC loops. Deionized water is quite a bit more corrosive as all the ions have been removed, and the water will actively pull metal ions out of the radiators and blocks. This makes deionized water a great choice for cleaning and flushing, or

mixing into concentrated fluids such as PrimoChill True.

EP: Deionized water is actually not a bad idea. But even a little contamination in the water can lead to problems. Contamination can happen in a lot of ways, which is why I always recommend using a few additives to avoid these problems. A lot of users never have a problem using just distilled water, but we know of quite a few who’ve had less luck.

Q: What purpose does a coil of bare silver serve in a liquid cooling system?

ES: For a minimalist approach to water cooling with distilled water and no additives or inhibitors of any kind, silver coils effectively prevent microbial growth.

Advertisement

EP: Silver kills bacteria and micro-organisms to prevent a buildup of fungi or algae, and this works well with distilled water. Most users in Europe and Asia use colored ready-to-use mixes that already contain additives that make silver unnecessary. In the USA, some still use silver, but this is only necessary with clear water. If your system uses aluminum mixed with copper, then you need an anti-corrosion agent, meaning another additive that makes silver unnecessary.

Q: What are the drawbacks, if any, to using opaque fluids?

ES: Any additive beyond growth inhibitors, corrosion inhibitors, and wetting agents are unnecessary. Every additional ingredient raises the likelihood of something undesirable happening. We recommend clear fluids, PrimoChill True Transparent, or PC Ice for users who want to go as long as possible without loop maintenance. If you want color without too much trouble, opt for a clear blue or green. UV-reactive, red-colored coolant, and opaque coolants can lead to gunk accumulating in block fins. I use opaque fluids, UV, and all the fun stuff, but I also accept that I will be

tearing my loops down, cleaning parts, and tossing tubing every 6 months. For me, the look of using a coolant like PrimoChill Vue fluid is worth the extra effort.

EP: There aren't really any serious drawbacks to transparent, colored coolants unless used with tubing that contains a lot of plasticizers, which can lead to discolored tubing and even sediment. Pastel [opaque] colors are a different story. These have a huge quantity of coarser color particles that can lead to clogs in a cooler's ducts. When off for a week or more, particles will settle in your reservoir, which can lead to pumps not starting. Many of these coolants also use titanium dioxide, which can damage many different types of pumps. If you're using one of these fluids, you should keep in mind that they are much more high-maintenance.

Q: PrimoChill's PC Ice is a "low-conductive" coolant. Does this mean a leak won't immediately smoke my system?

ES: Low-conductive fluid only reduces the chances of a short—it doesn't prevent them altogether. We recommend keeping spills to a minimum

and protecting your hardware with towels while filling and testing for leaks. This brings up another good reason to change your fluid regularly: The longer fluid is in your loop, the more conducive it becomes from picking up metals from the components. A leak with 9-month-old fluid is much more dangerous than a leak of fresh fluid.

Q: What does a pretreatment do for your loop? Is it necessary?

ES: While the goal of pretreatments are all the same, they achieve their goals in different ways. Some simply aid water in picking up and carrying away debris and flux from the radiators, some actively lay down a layer of protection while cleaning the radiators, and some come as a two-part system that first actively eats away at the inner surface of radiators, blocks, and fittings, with a second part following it that neutralizes the first part. Pretreatments are good and help prevent problems, but a good flush with DI (deionized) water may be enough if you have very clean radiators and parts to start with. PrimoChill includes their pre-treatment SysPrep whenever you buy retail packaged flexible tubing or True concentrated fluids.

Q: How should one go about changing fluid types in an active loop?

ES: If you change colors or even switch fluid types entirely, it's best to get the loop as clean as possible beforehand. This involves repeatedly flushing the system to check to see if the water stays clear or becomes cloudy or picks up color. If you experience issues with the new fluid mixing with residue from the old fluid, there is no other choice but to drain and start over.

EP: If you're using normal colored or UV water, you just need to rinse the system with distilled water. With opaque coolant, you should take the cooler apart and clean the ducts and fins with a toothbrush. If you use special cleaning fluids, inspecting the cooler is still recommended. ■



Alphacool's Cape Kelvin Catcher features a number of anticorrosive and antimicrobial additives, making it ideal for any liquid cooled system.

RAID-Ripper

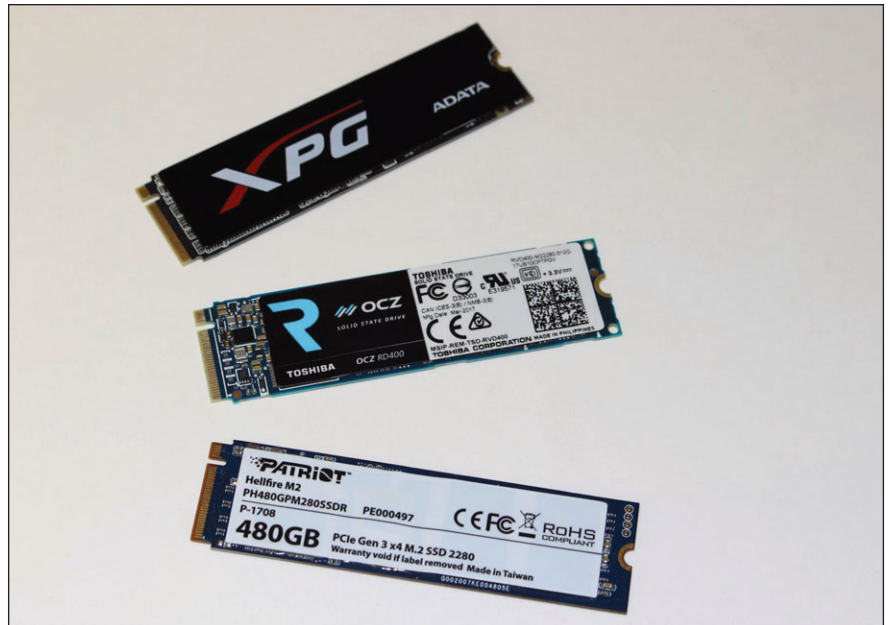
Let's Build A Bootable NVMe RAID Array With Threadripper

In our recent head-to-head review of the AMD Ryzen Threadripper 1950X and the Intel Core i9-7980XE, we gave AMD's aptly named chip the nod, largely due to its impressive price/performance ratio and the astonishing number of PCIe lanes it supports. But today, in the waning months of 2017, both AMD and NVIDIA are actively downplaying the benefits of running multiple GPUs in a system, and even limiting their driver support to just 2-way SLI and CrossFire. DirectX 12 has yet to become the multi-GPU messiah it was proclaimed to be, which may leave you wondering why on Earth anyone would need 60 PCIe lanes. The short answer is ultra-fast storage, and lots of it.

Just as Intel was patting itself on the back for its flagship Core i9-7980XE launch, AMD announced that it was offering bootable NVMe RAID support for its entire Threadripper lineup, for free. At first glance, this sounds like an attractive no-brainer for the X399 enthusiast-centric platform, but if you read between the lines, this is yet another way that AMD is going after Intel like a pit bull with a squeaky toy. And enthusiasts are reaping the rewards.

RAID's New Ride

RAID is not exactly the new hotness, but what we're talking about here, a RAID array driven directly from the PCIe lanes on the CPU, is a very different thing from a traditional RAID array communicating with the CPU from a controller in the chipset. There is a distinct advantage to routing your NVMe SSDs through the PCIe lanes of the CPU rather than through the bandwidth-limited chipset that also handles the I/O for multiple other non-storage devices. For AMD, this is a 4-lane PCIe 3.0 link and on Intel, the DMI3.0 interface handles off-processor NVMe SSDs. Both offer roughly equivalent bandwidth. Back when SATA SSDs were the peak of



Using three mismatched drives in a RAID 0 may not be ideal, but we'd wager that it's very common.

storage performance, you'd have had a hard time creating an array that could saturate that pipe, but with the dawn of NVMe SSDs, all that has changed. Now, a single NVMe SSD needs four dedicated PCIe 3.0 lanes to reach its full potential, and an array assembled from four NVMe drives requires a full 16 PCIe 3.0 lanes. Today, enthusiasts have access to the hardware, the software, and as ever, the burning desire to see just how fast storage can get.

Intel's Bootable NVMe Headache

On Intel's platform, X299 desktop platform users can only run bootable RAID with the Skylake-X-based processors, so anyone who bought a Kaby Lake-X is left out in the cold. (You can't say we didn't warn you). According to ASUS, the company that manufactures the Hyper M.2 PCIe card (more on this later), motherboards that support bootable NVMe RAID should let

you create a RAID 0 (striped volume) array without too much fuss. According to Intel, however, only standalone NVMe drives will operate in a VROC (Virtual RAID On CPU) Pass-Through mode. We reached out to Intel for clarification, but had not heard back as we went to press. While we don't know for sure if RAID 0 is "free" or not, the one thing we do know is that RAID configurations that support redundancy, such as RAID 1, 5, and 10 are not free.

To unlock these options, you'll need to purchase a Standard or Premium VROC key for RAID 0/1/10 and RAID 0/1/5/10, respectively. We don't know how much these keys will cost you because Intel has yet to officially launch the product for Core processors on the HEDT platform.

Initially, it was revealed that only Intel's own SSDs would be bootable with VROC, and we confirmed that this information is included in the manuals

for more than one X299 motherboard we have in our lab. Again, according to Intel's VROC FAQ, however, select third-party SSDs may be allowed. This document also recommends you turn to OEMs and ODMs for information on obtaining a system to support bootable NVMe RAID via VROC. But we're enthusiasts, and we spell "OEM" with the letters D-I-Y.

Another limitation on Intel's platform is that although the Skylake-SP processors support three VMDs, or volume management devices, only one of them can be bootable. A VMD takes a block

AMD's Bootable RAID Alternative

As with Intel's solution, bootable NVMe RAID on AMD's platform is limited to the high-end segment, namely the X399 motherboards and Ryzen Threadripper processors. The current Threadripper SKUs all support the same number of PCIe lanes, and there are 60 in total after accounting for the four dedicated to the chipset.

Prerequisites for creating an insanely-fast RAID array include a motherboard that features the RAID special sauce, two or more M.2 NVMe SSDs of any brand and model, and a fresh copy of 64-bit Windows 10. AMD specifies build version 1703, but

a bootable NVMe RAID array that consists of eleven SSDs, but that's not the case. There is a device limit. According to AMD, you can run up to seven distinct PCIe devices "without adapters," leaving you with a graphics card and six NVMe SSDs as the most likely configuration.

The motherboard we're using is the GIGABYTE X399 AORUS Gaming 7, which features three native M.2 NVMe slots, and there's even a spiffy heatsink and thermal pad for each one. If we look at a chipset diagram of AMD's X399, this is the maximum number of dedicated M.2 x4 NVMe slots supported on the platform.

In order to cram any more NVMe SSDs onto this board, we'd need to install something like the ASUS Hyper M.2 PCIe card (bitly.im/hGjpn), which only works on motherboards that allow the CPU to split PCIe lanes into subgroups sans a PLX chip. On X399, there are two x16 slots and two x8 slots, which we'd traditionally populate with graphics cards. In the absence of this device, we set up our system with three of the top-performing SSDs from our recent NVMe roundup.

The ADATA XPG SX8000 512GB (\$319.99) features an integrated heat spreader affixed to the top

Although the purpose of an FAQ is to clear up confusion, Intel's VROC FAQ seems to create more.

of 16 PCIe lanes and divides them into a quartet of x4 segments for hosting up to four storage devices. For a refresher, Intel's Z170, Z270, and Z370 platforms all support bootable NVMe arrays of up to three devices, but these will rely on chipset-based PCIe lanes. Intel's platform is also rather stingy when it comes to CPU-based PCIe lanes, which is another limiting factor you'll have to consider when trying to trick out your system with a bootable array of NVMe SSDs. If all this sounds needlessly complicated, that's because it is.

we encountered no issues running version 1607. You can't port an existing RAID array over, so you'll need to install Windows after configuring the array for the first time.

Once the array is setup and running, you can install AMD's RAIDXpert 2 software utility by visiting bitly.im/vdCpI and clicking the top hyperlink under the NVMe RAID Support Software subhead. We'll talk more about how you can use this application later.

Hardware Options

We know what you're thinking: With 60 PCIe lanes, you could create

of its Silicon Motion SM2260 storage controller chip. This is the same controller in Intel's SSD 600p series of mainstream PCIe SSDs, but here it's paired with the superior-performing 3D MLC NAND. Uniquely, this drive uses a cache of SLC NAND for a slight performance bump. On paper, the 512GB SX8000 manages sequential reads and writes of 2,500MBps and 1,100MBps, respectively, in CrystalDiskMark. In random 4KB reads measured by the benchmark, the drive achieves 140,000 IOPS. In random 4KB writes, it hits 150,000 IOPS.

The Patriot Hellfire NVMe SSD (\$259.99) is Patriot's flagship drive, and it's available in two capacities, 240GB and 480GB. We used the larger one for our RAID array. Phison's PS5007-E7 storage controller lies at the heart of this SSD. Toshiba's 15nm NAND flash forms the bulk of this card's surface area, on both sides. For its onboard cache, Patriot installed 512MB of DDR3L. The Hellfire box reports that this drive is capable of CrystalDiskMark sequential reads at up to 2,550MBps and writes at up to 1,260MBps. Random 4K writes are up to 210,000 IOPS and 4K reads up to 170,000 IOPS.

The third drive we selected is Toshiba's OCZ RD400 512GB (\$239.99). According to Toshiba, this 512GB SSD is capable of 2,600MBps and 1,600MBps sequential reads and writes, respectively, when testing with ATTO. Using Iometer to measure the RD400's random 4KB performance, Toshiba recorded reads up to 190,000 IOPS and writes up to 120,000 IOPS. The RD400 relies on the Toshiba TC58NCP070GSB controller, and the NAND consists of 15nm Toshiba MLC. Toshiba also sells a version that includes a PCIe x4 adapter card, for a modest \$20 premium.

As you can see, we chose three different drives, with varying capacities. This was no mistake. We've seen a handful of NVMe RAID articles popping up here and there and they're generally all on Intel's platform and all consisting of identical drives. For our article, we wanted to see if AMD's X399 RAID implementation had any quirks that might prevent drives with different controllers, NAND types, and architectures from working as you would expect in a more traditional RAID setup.

Benchmark Remarks

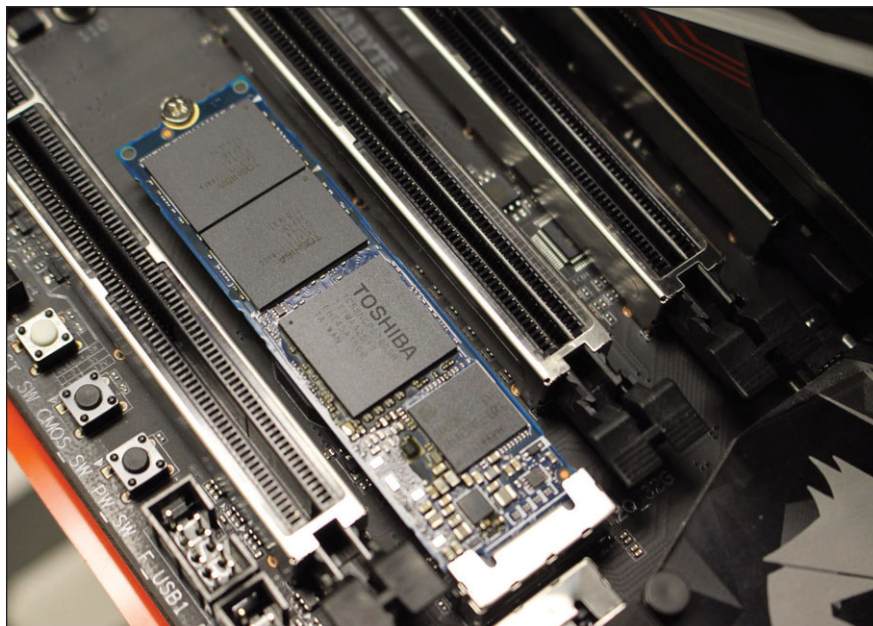
Prior to building the array, we took one of the faster NVMe SSDs we used, the 480GB Patriot Hellfire, installed Windows on it and ran a series of benchmarks to get a baseline for comparison. On the GIGABYTE X399 AORUS Gaming 7, you can plug in

between one and three NVMe SSDs and a Windows-based system will recognize them immediately as standalone drives.

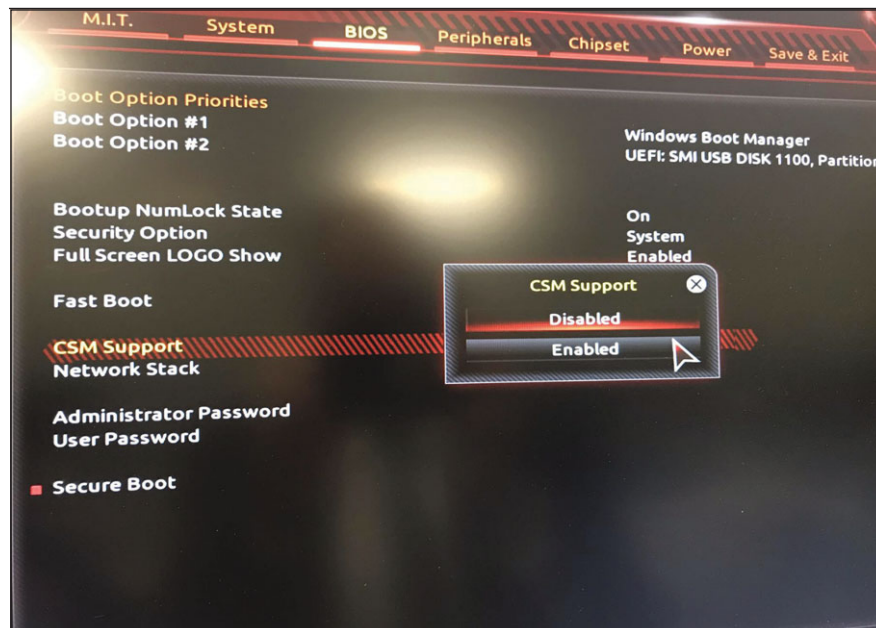
To determine our baseline and see how much faster our RAID 0 array was in comparison, we used a trio of common synthetic SSD benchmarks, including ATTO Disk Benchmark (version 3.05),

CrystalDiskMark (version 5.2.2), and AS SSD (version 2.0.6). For the data that appears in the charts, we ran each test four times, dropped out any scores that were inconsistent with the others and averaged the rest.

ATTO is one of a handful of industry standard tools that's widely



Our Toshiba NVMe drive is ready for its close-up.

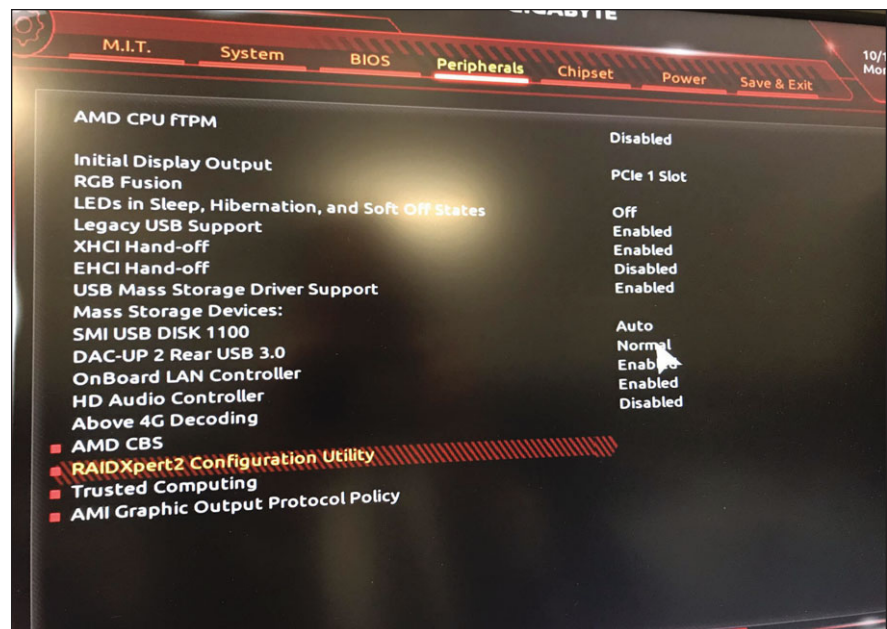


Once you've updated the BIOS, you need to disable CSM Support to get the RAIDXpert 2 utility to appear.

used by both manufacturers and users, particularly for testing SSDs, storage controllers, and RAID arrays. We didn't include the ATTO scores in an easy-to-compare chart largely because the results screen already displays read and write performance in a bar graph format. ATTO relies on much smaller file transfer sizes, from 512B to 64MB, and a total transfer length of 256MB.

CrystalDiskMark is one of the more high-profile SSD and HDD benchmarks around, and we use it for a variety of testing scenarios. The big drawback with this benchmark is inconsistency between runs, especially when you're testing the drive as a boot device, as we are in this scenario. To work around the all-too-common one-off low scores we sometimes encountered, we devised the multi-run averaging scheme described above. By default, this benchmark runs the workload five times for each of the five tests and the test size is 1,024MB.

AS SSD is a storage benchmark that produces results that may look very similar to those of CrystalDiskMark. The primary difference here is that AS SSD includes data that the



From this BIOS menu item, you'll be able to create, manage, and delete RAID arrays.

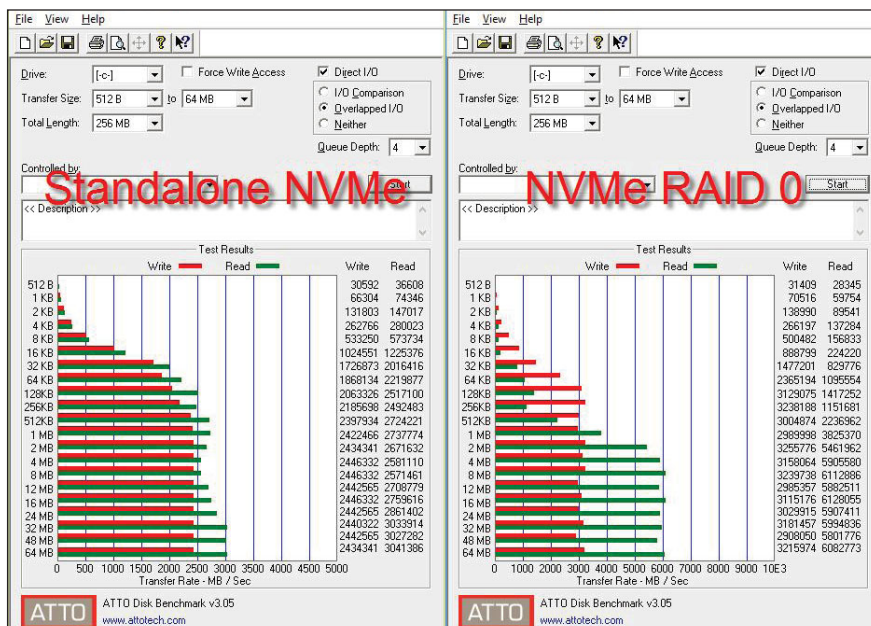
device's controller can't easily compress, including photos and videos. With any high-capacity RAID 0 array, there's a high likelihood that you'll be working with multimedia files on a routine basis, so testing for that is important.

The tested file size was set to the default of 1GB.

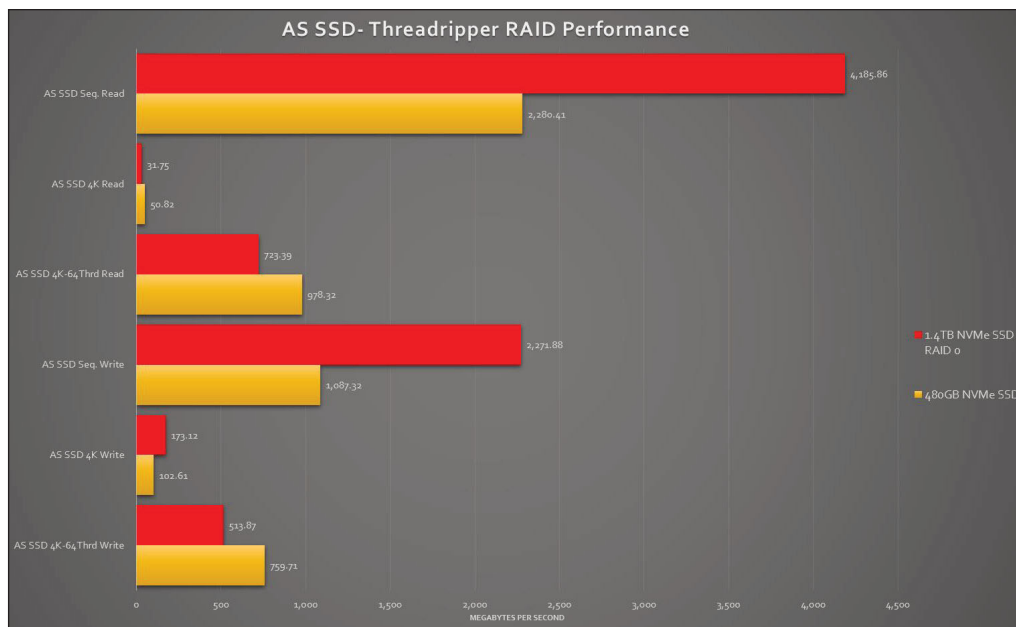
Step-By-Step RAID Setup

While we're writing this tutorial in such a way that you should be able to follow along to repeat our success, if you're using a BIOS version later than the version we used, you may not encounter the same menu items. For the RAID setup procedure, we largely relied on the GIGABYTE X399 AORUS Gaming 7's manual. If you're using a different motherboard, look to your manual for the required procedures.

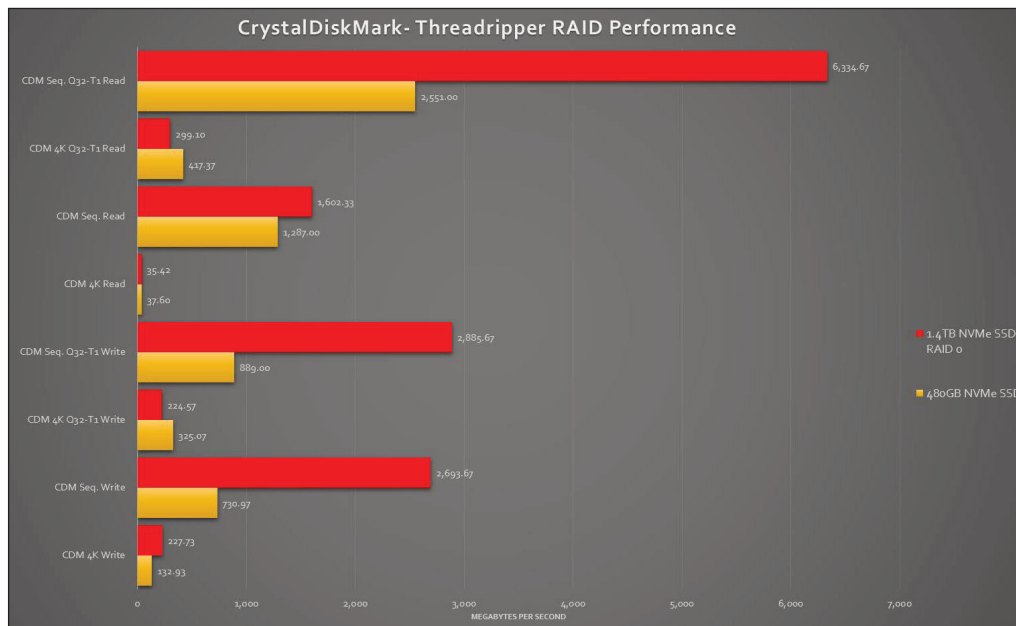
At the start, we had all three NVMe drives installed and formatted as blank drives. We performed the early steps, including the BIOS update, using an auxiliary SATA SSD with Windows 10 installed. At this point, it's a good idea to download the RAID drivers and have them ready and waiting on a flash drive. To do this, visit bitly.im/vdCpI and click the "Standalone NVMe RAID Driver for Windows 10 Installation of Windows 10 64 Bit" hyperlink. Once the compressed file folder is downloaded, extract it onto a flash drive. The folder in question will be titled RS2x64. Set



ATTO shows us where the RAID 0 array shines, and where the latency of a single device is hamstringing the array's performance.



AS SSD's sequential benchmarks, in red, show off the RAID 0 array's strengths.



CrystalDiskMark's numbers mirror those of AS SSD, with the large sequential tests showing the biggest improvements.

the flash drive aside until you're ready to install Windows.

Before we continued, we needed to update our motherboard's BIOS. GIGABYTE released its NVMe RAID BIOS update on October 3rd, in the F3g version. We downloaded the

BIOS to a flash drive, then pressed the END key during the POST to access GIGABYTE's Q-Flash utility. Consult your motherboard manual for the proper procedure to follow to update your BIOS. Once in the utility, we could browse to the location of the new BIOS

file and initiate the upgrade with just a few clicks.

After a restart, the UEFI setup menu now features a hidden RAIDXpert 2 Configuration Utility that'll let us create our array. In order to reveal the menu item and allow the system to recognize the array once Windows is installed on it, however, you'll need to change a few other settings. First, we had to navigate to the UEFI's BIOS submenu, then set CSM (which is short for Compatibility Support Module) Support to Disabled. The manual also tells us to set the Windows 10 Features to the "Windows 10" setting, but this option had been removed from the menu in the GIGABYTE X399 AORUS Gaming 7's F3g BIOS. Next, we pressed F10 to save the changes and restart the system. We reentered the UEFI Setup menu to find the RAIDXpert 2 Configuration Utility item in the Peripherals submenu.

After getting into RAIDXpert 2, you're faced with three menu items, Controller Management, Array Management, and Physical Disk Management. To proceed, we chose the middle option, Array Management. Next, we clicked Create Array, chose "RAID 0" as our RAID Level, and then clicked the Check All option under the Select Physical Disks

menu item. If one or more of the drives is not appearing in this screen, you may need to back up to the Physical Disk Management menu item to ensure the drives you plan to use for your array are online. Finally, we clicked Apply Changes. The remaining menu items let

you tweak the array parameters, array size, read cache policy, and write cache policy. We left these at the default settings and then clicked Create Array. At this point, we were ready to begin the process of installing Windows, so we plugged in our Win10 installation drive (which we'd prepared in advance), then pressed F10 to save the changes and reboot the system.

Next we booted to the Win10 installation drive and the familiar Windows 10 Setup procedure began as normal. We followed the on-screen steps for a Custom installation until we got to the stage where the setup asks where to install Windows. Instead of clicking one of the partitions visible in the list, we clicked the Load Driver hyperlink at the bottom of the screen and browsed the thumb drive with the RS2x64 folder on it, as described above. On the Select The Driver To Install screen, we chose the AMD-RAID Bottom Device (C:\RS2x64\rcbottom.inf) item and clicked Next. Again, ignore the list of partitions that may or may not appear (there were no eligible partitions for us after this step), but click Load Driver again, this time choosing the AMD-RAID Controller [storport] driver and clicking Next.

Back on the Where Do You Want To Install Windows screen, you should see a Drive 0 Unallocated Space item that features the total capacity of your new array. For our batch of twin 512GB drives and one 480GB drive, our total capacity was listed as 1.4TB. We clicked the item, clicked new, and then proceeded to install Win10 as normal.

Write tests also regressed under our RAID 0 array. But these mediocre random read and write scores were completely blown away by the array's sequential read and write performance. Highlights include 73% faster sequential write score, 69% faster sequential Q32-T1 write score, a 42% faster 4K write score, and a 60% increase in the sequential Q32-T1 Read score in CrystalDiskMark. AS SSD reported increases of between 40% and 52% in 4K write, sequential write, and sequential read scores.

The reason we saw some scores decreased is due largely to the size of the data transfer. For instance, in a 4KB random test, the transfer is limited to a single stripe, so the result depends more on the latency of the individual drive than the array. The depth of the queue also has an impact. Tests with a queue depth of one will show poorly with a RAID 0 array, but higher queue depths will be able to span multiple drives. Luckily for anyone thinking about creating an incredibly fast array with NVMe drives, the transfers that tend to not benefit much are typically small and brief. It's the massive sequential reads and writes that get the biggest boost,

The RAIDxpert 2 Utility

Once in Windows, you can continue to manage the array using the UEFI BIOS menu's RAIDxpert 2 utility, or you can install the Windows-based RAIDxpert 2 Management Tool. You can download it by visiting bitly.im/vdCpI and clicking the "NVMe RAID Driver and RAIDxpert2 Management Software for Windows 10 64 Bit" hyperlink. Once the utility is installed, you can double-click the desktop icon to display the sign-in screen in your default web browser.

Sign in the first time using "admin" for both the username and password, and you'll get the opportunity to choose a new username and password on the subsequent screen. Once the management tool loads, you'll be able to view all sorts of details about your RAID array.

RAID Away

After following the straightforward procedure to create a RAID array and enjoying the resulting speed boost, we see no reason fellow Threadripper owners should avoid doing the same. It's easy, it's "free," and the benefits

</

AMD's RAIDxpert 2 Management Tool is a lightweight application that makes it easy to see how the array is faring.

The Results

When we look at our AS SSD results, we see a few instances where our RAID 0 array is slower than the standalone drive, including in the 4K 64-thread Read/Write tests and the 4K Read test. CrystalDiskMark's 4K Q32-T1 Read/

and they're the ones that you want sped up the most.

Depending on the applications you perform, altering the strip sizes can juggle the numbers a bit, but that's a topic for another time.

are tangible. The only drawback we see is the upper limit of three M.2 slots you'll encounter with most X399 motherboards, keeping you from enjoying a fast array with built-in redundancy. ■

Modder Q&A: James Fislar

Scratch Builder, Gamer & FortLAN CEO

James Fislar won *CPU's* "Mad Reader Mod" contest in May 2011 with his Lenovo K320 Ice mod, which replaced the outer panels of a Lenovo PC case with translucent resin panels with a cool ice effect. Other Fislar projects have appeared in our pages, as well, including the super-cool Gamers Outreach PC he built in honor of the charitable organization that runs the Gamers for Giving LAN event and his MSI Vortex Robot mod, which won a Vortex-modding competition at PDXLAN last year. Fislar is also CEO of FortLAN, a regular LAN event in Fort Wayne, Indiana that has grown by leaps and bounds.

Q: How long have you been modding PCs now, and how did you get started?

JF: I've been modding 10 years, it really came from the LAN scene back in 2003 and 2004. I was always seeing people do crazy things with their computers.

Q: Do you remember your first mod? What was it and how did it turn out?

JF: I made my first PC case from scratch in 2007 out of clear acrylic with an aluminum housing. Watercooling was starting to take off, and I used a combination of Thermaltake and Danger Den parts. My builds have always been brightly lit, mainly because LAN parties were usually pitch black, and so they really stood out well.

Q: How did you come up with the idea for using resin to make panels like you did with the Lenovo K320 Ice?

JF: I continuously looked for ways to frost acrylic to look like ice and I saw a crafting post on how to make fake ice cubes with resin and foil. I entered the Lenovo contest with a concept based on a smaller Intel Atom case shell that I made of resin. I really wasn't sure I could pull it off, since it was 100 times bigger than the ice cubes and was a very expensive project—the resin was \$300 for a five-



Fislar and his Mad Reader Mod-winning Lenovo K320 Ice mod.

gallon drum. I made a gel mold of the front panel and framed up the rest of the molds with wood and used clay to seal the cracks. Next up was laying the foil, mixing the resin with a hardening agent, and pouring into the mold after spraying a releasing agent. I anxiously waited 24 hours, but still wasn't sure if it would work. So I started over, rebuilding the frame with I-shaped aluminum, which meant I had to learn to rivet. I ended up using the new ENERMAX VEGAS

TRIO fans, and I was able to really pull off the ice effect.

Q: Did you build other resin-panel cases, as well?

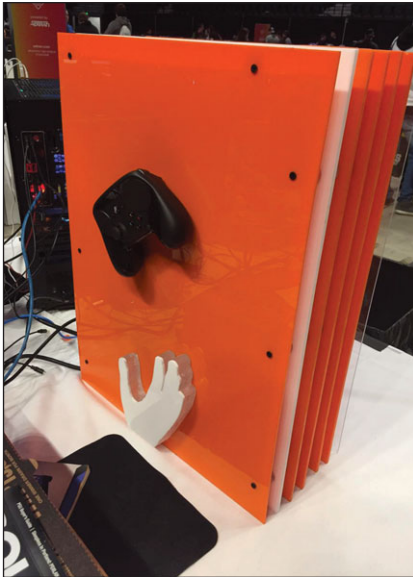
JF: I built three other resin PCs after that, including one that was displayed at the ASUS Xtreme Systems event at CES in 2011, a SAPPHIRE edition displayed at E3 2012, and a final one called "Fire and Ice" that was displayed at QuakeCon in 2013.

Q: We really dig the Gamers Outreach mod you built; how did you get involved with Gamers Outreach to begin with?

JF: I met Zach and Brian in 2015 at the Gamers for Giving event. The very next year we started talking about their event while packing up at QuakeCon. They asked how much it would cost for a custom PC for their event, and I said I would love to donate one for such an amazing cause. Handshakes and smiles later, I was all in to create a very unique scratch build for them. Many sponsors jumped on board, including Intel, EK, EVGA, and NVIDIA.

Q: How many events has that mod been to now?

JF: The charity winner brought the mod to the 2016 events and sat



Fislar donated his time and rallied sponsors to build this gorgeous Gamers Outreach PC that was sold at a charity auction at a Gamers for Giving event.



a red and black dragon skin feel. The robot actually moved on voice commands or via phone app. It was really one of my favorite projects, and I learned how to hydro dip in the process.

Q: You did another mod in conjunction with MSI, correct?

JF: It was a pretty cool dragon mod. I made the MSI dragon from scratch with acrylic and about \$10 of scrap wood from Menards, hand-cut with a scroll saw. It was about a 10-hour process from start to finish. I used the dowel rods and cut the fan holes out with a drill and rounded the edges with a handheld router for the base. The mod was on display at CES 2015 in the MSI suite. When JayzTwoCents, Linus Tech Tips, and Gamers Nexus use your build as a cover pic for their intros of CES and include it in their video coverage of MSI's booth, it's an awesome feeling, like you had one of the best builds at CES!

Q: Tell us about FortLAN! How did you get involved with that?

JF: FortLAN is a local LAN party in Fort Wayne. We host gaming events from 100 to 300 attendees, three times a year, and take donations to help our local charities. The original FortLAN was run by a computer shop called Alpha PC here in Fort Wayne from 2004 to 2006. Around 30 to 50 gamers would attend and enjoy BBQ, gaming, and meeting fellow enthusiasts. It really impacted my love for computers and gaming. In 2012, while on our way to QuakeCon, David Delamater, Haley Mullins, and I began to plan the rejuvenation of FortLAN. We listed the pros and cons of LAN parties we had attended and tried to come up with the best format for our events.

Q: How many attendees did your first FortLAN event have, and how many did you have at the latest event?

JF: We started out hosting mini-LANs with around 30 attendees



Fislar has created two awesome mods for MSI: The first (left) is a mod of the company's Vortex SFF PC, the Vortex Robot. Second is an open-air build based on MSI's iconic dragon.



directly across from me; it was really cool to see it again in person and make a few minor repairs so the owner could keep displaying it.

Q: Do you still have the Vortex Robot mod that won the MSI contest at PDXLAN in 2016? What can you tell readers about that project?

JF: The Vortex Robot is somewhere at MSI's home office. MSI took my concept to convert the Vortex shell into a functional robot. I integrated a small robotics kit from "Toys R Us" into the case, converting the top cover and making it look like a head. Then I "hillbilly hydro dipped" the parts (used warm water, a Rubbermaid tote, and a hydro kit) to give it

in December 2012. Once we started developing a good following, we had our first official FortLAN in 2013 with close to 80 attendees; after that we sold out our events for the next three years. In 2016, we created and launched FortCON and moved into a larger venue. We had more than 200 BYOC attendees and around 80 general admission attendees. Our most recent event had around 250 BYOC attendees and around 120 General admission. We have room to grow at our current venue to be over 500.

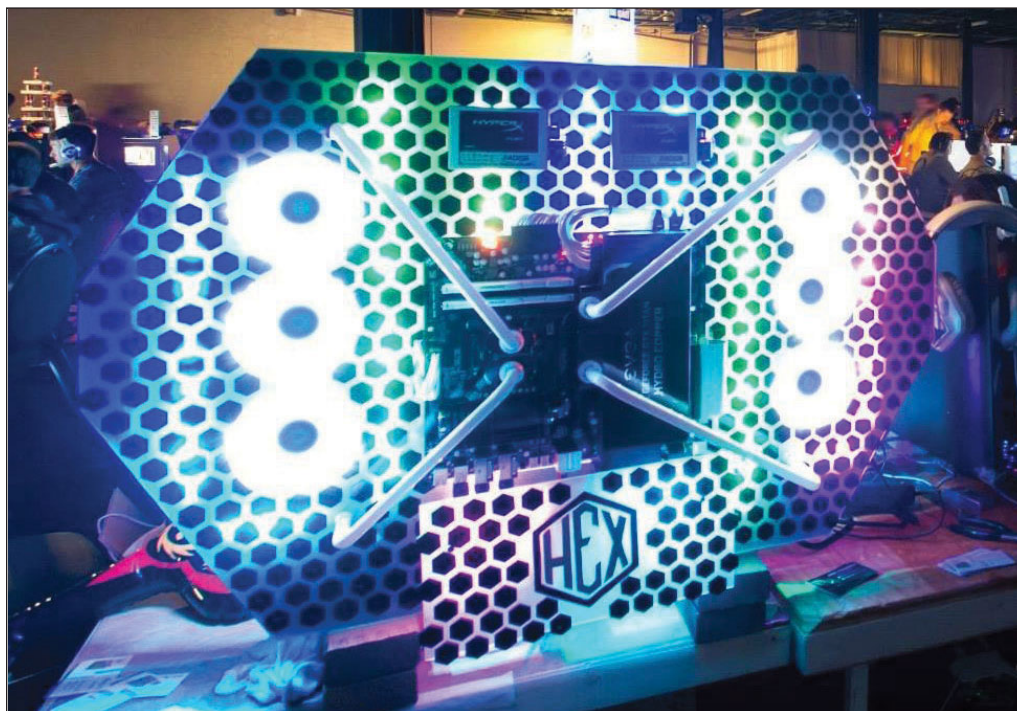
Q: What's the next FortLAN event on the schedule?

JF: We will be hosting three events in 2018: February, June, and FortCON 2018 in October.

Q: What's your favorite mod of all the projects you've done, and why?



Fislar's QuakeCon 2016 build.



Fislar's favorite project, HEX, a cooperative build completed with Haley Mullins.

JF: The scratch build HEX mod that Haley and I worked on in 2015 For QuakeCon. We didn't have a lot of time before the event; we built it in about two weeks. I didn't even boot it up until I was at the event. I added more than 250 laser-cut hexagons bonded onto hand-frosted acrylic with dual radiators and a waterfall reservoir. We used a Dremel for most of the cuts. The RGB lighting and effects were awesome! This is what scratch building is about.

Q: What is your greatest strength as a modder, and what's the thing you'd like most to improve?

JF: I love the room I have to be creative and make a project from scratch, learning as I go. I try to improve each build, to make each one better

than the one before. I'm currently working to improve my airbrush skills.

Q: It's time for Five Quick Questions!

1) Case modding or scratch build?

I do some case modding but scratch is where my heart lies.

2) Airbrush or Dremel?

Dremel!

3) Threadripper or Skylake-X?

Streaming or gaming?

4) "The Force Awakens" or "Rogue One"?

Rogue One.

5) Overwatch or PUBG?

Team vs. solo—I actually like them both. ■

Mod Project

A Beginner's Guide To Etching Tempered Glass

For many of us, thoughts of modding our PCs usually end abruptly when we realize just how many expensive, specialized tools the pro modders use. But in our countless conversations with the modding superstars featured in the pages of this magazine, we're constantly reminded that when they started out, an ounce of creativity was worth more than a pound of CNC router.

To that end, we're going to try our hand at etching a tempered-glass window panel without using a laser engraving machine. All we'll need is a few household items, some inexpensive but readily available items, a design we like enough to permanently tattoo to a case panel, and a pinch of creativity.

Shopping List

The case we'll be modding is the Phanteks Enthoo EVOLV ATX Tempered Glass Edition, which features two tinted tempered-glass side panels. Household items you'll need include masking tape, an X-ACTO knife, glass cleaner, eye protection, and a cheap

plastic-bristle paint brush. If you don't have one or more of these items, they can easily be acquired for just a few bucks each.

Items that you probably don't have readily at hand include a sheet of adhesive vinyl; protective rubber, latex, or vinyl gloves; and a glass-etching chemical compound. Again, most of the above can be acquired for a pittance, but the glass-etching compound is the component you'll probably need to get at a specialty craft store or online. For this project, we used Armour Etch (www.armourproducts.com) glass-etching cream. The large, 10-ounce bottle we purchased cost us less than \$20, ensuring we had enough to cover the 15 x 15-inch CPU logo design we settled on. If you're planning on creating a much smaller design, the 2.8-ounce bottle of Armour Etch can be had for just over \$10. To give you an idea of how far this stuff will go, our design required approximately half of the 10-ounce bottle.

Stencil Design Tips

When choosing a design, you may be tempted to go big—like we did—but because you'll have a hard time applying an even layer of the cream to large exposed areas, those areas will tend to etch unevenly, leaving spots, lines, and other irregularities visible in the finished product. The Armour Etch manual also states that striations not visible on the glass surface may appear after etching. Thin lines, fine details, and lettering all tend to work well with glass-etching cream. Remember, the design etched into the glass will appear white compared to the rest of the tinted panel, so monochrome designs with hard lines are ideal.

You can make short work of your stencil and forgo cutting out a vinyl design by simply purchasing a commercially-available vinyl sticker. You might also consider buying a ready-made vinyl sticker, and then cutting out its background, or foreground, to create your stencil.



Armour Etch is a glass-etching compound that lets you mod your tempered-glass panels without dropping a small fortune.



Our design was created using a vinyl cutter like this one, courtesy of BS Mods. But you can go the manual route and still get amazing results.



Spreading the Armour Etch evenly was difficult with our tiny brush, so we recommend using a wide brush if you have large areas to cover.



We're pleased with the result, and even happier that we managed it on a tight budget.

The Etching Hour

If you'd rather go for something more personalized, the best place to start is with a printout of the design, to scale. Then apply the design to the vinyl sticker's cover sheet, or the vinyl itself, using a pencil or

fine-tipped permanent marker. The next step is to use the X-ACTO Knife to cut out the design, making sure to keep the backing fully intact. The best way to do this is to use some masking tape and mount the vinyl sheet to a surface you can cut into, such as a

self-healing cutting mat, cutting board, or thick cardboard. Take your time, use sharp blades, and always handle the knife safely.

Once the vinyl design is cut out, clean the surface of the tempered glass panel with glass cleaner and dry it thoroughly. Next, apply the vinyl design in the desired position and mask off the outer edges of the design by a few inches using masking tape. It's important, particularly for large designs, to ensure the vinyl is fully adhered to the panel, especially those fine edges. If the glass etching compound makes its way under the sticker due to an errant air bubble, you will not like the end result.

When you're satisfied that the vinyl design is in place, remove the top sheet and inspect it for air bubbles. If you need to work any air bubbles out, take care not to touch the glass panel where you plan to spread the etching compound, as the oils from your fingers may prevent a good etch.

When you're ready to spread the Armour Etch, make sure to first read and follow all instructions. Use the product only in a well-ventilated area, use eye protection, and wear gloves at all times. This stuff can chew through tempered glass, so you probably don't want to find out what it can do to your skin.

According to the Armour Etch instructions, the cream is meant to be left in place for five minutes, after which it should be washed off. Because our design was so large, it took us about ten minutes to apply using a small paintbrush. Once we had the cream covering every portion of the exposed tempered glass, we let it sit for a full five minutes, then took it over to the sink to wash the cream off. The extra time didn't seem to affect our results, so leaving the cream on for more than five minutes in portions shouldn't pose a problem. Once the panel was clean and dry, we immediately removed the vinyl to reveal the finished results.

Mod By Numbers

Although a laser etching would have resulted in a perfectly even etch, we're still quite pleased with the end result. This is a mod that virtually anyone can do, and for relatively little money. Don't worry, dear reader, we won't quit our day jobs just yet. ■

The Evolution After The Revolution

AMD & NVIDIA Build Upon Last Year's Architecture Updates

Whether you're Team Red or Team Green, or just like seeing massive GPU improvements, 2016 was a year to remember. NVIDIA introduced its Pascal architecture and AMD followed with Polaris. So far, 2017 hasn't seen the same level of GPU innovation, but both AMD and NVIDIA have made steady upgrades to their existing product lineups. And with AMD's recent Vega launch, Team Red now has a GPU to compete in the high-end arena with NVIDIA. If you're running a two-year-old or older graphics card, our graphics card buyer's guide will be well worth your time.

Flagship Forces

NVIDIA's GeForce GTX 1080 Ti is the current king of gaming GPUs. Interestingly, Team Green uses the GP102 found in the Pascal-based Titan X, instead of the GP104 in the GeForce GTX 1080. The GeForce GTX 1080 Ti is a gaming powerhouse with 28 streaming multiprocessors, 3,584 CUDA Cores, and 224 texture units. Respective base and boost clocks on the Founder's Edition are set to 1,480MHz and 1,582MHz, while the 11GB of GDDR5X is clocked at 11GHz. AMD's new Radeon RX Vega 64 doesn't quite stand up to the GeForce GTX 1080 Ti, but it is in the GTX 1080's ballpark. The reference, air-cooled version of the Vega 64 has base and boost clocks set to 1,247MHz and 1,546MHz, respectively. And with 8GB of HBM2 VRAM (clocked at 1,890MHz), memory bandwidth comes in at 483.8GBps.

The Digital Currency Mining Elephant In The Room

The resurgence of cryptocurrencies, in combination with incredible gains in GPU power efficiency, caused supply shortages and generally raised prices for mid-range graphics cards this summer. AMD's 570 and 580 models, as well as NVIDIA's 1070 and 1060 GPUs, were most affected. AIB board partners responded by producing more of the mid-range cards to meet demand, but you're still likely to see a \$100 markup (or more) above a GPU's original MSRP. Without an end to the cryptocurrency mining craze in sight, mid-range GPUs are no longer the "bang for the buck" stars they have traditionally been.

Render Your Own Verdict

Our buyer's guide consists of GPUs for all types of budgets, and most of the options boast beefy coolers and aggressive factory overlocks. Many of the custom coolers add a style of their own to the GPU, with LEDs, striking GPU backplates, or both, to improve the aesthetic of your build. Our guide covers exactly why a particular GPU might be the best fit for you.

NVIDIA GeForce GTX 1080 Ti Founders Edition

\$699.99

www.nvidia.com

Why You'll Dig It: The Founders Edition cooler on the GTX 1080 Ti, like that on the GTX 1080 and Titan X before it, may look like a slight evolution of the reference design blower-style coolers attached to previous flagship cards, but we maintain that this card's cooler screams "premium." On this card, a vast majority of the heat generated by the GPU, VRAM, and VRM gets exhausted out the back of the PC case. The GTX 1080 Ti features a new seven-phase 2x dual-FET power design that provides the GPU with 250 Amps of power. There are 8-pin and 6-pin PCIe power ports on the top edge of the card. NVIDIA's engineers removed the bulky DVI output riser on the back bracket, which let them double the airflow area.

Who Should Apply: Small form factor systems where cooling options are limited and blowing heat across the rest of the components is deemed undesirable.

Base/boost clocks: 1,480MHz/1,582MHz

Memory type/speed: 11GB GDDR5X, 11,010MHz

Display connectors: 1 HDMI, 3 DisplayPort



GIGABYTE AORUS GeForce GTX 1080 Ti Extreme Edition 11G

\$879.99

www.aorus.com

Why You'll Dig It: To keep this GPU running cool and quiet, GIGABYTE modifies its Xtreme Gaming WINDFORCE cooler with a copper core behind the GPU built into the card's black, brushed-aluminum backplate. Over the top of the GPU and memory chips, GIGABYTE installs a large solid-copper baseplate, and on top of that there's a heatsink with angled fins threaded with GIGABYTE's 6mm and 8mm composite vapor chamber-like heatpipes. The middle fan in the trio of stacked 100mm double-ball-bearing fans spins the opposite direction, which spreads cool air over more of the PCB's surface. There are a plethora of outputs on this card, including three full-sized DisplayPort 1.4 ports and one dual-link DVI-D output. AORUS VR Link also lets you utilize two of the rear-facing HDMI ports, or take advantage of the card's internal HDMI port for connecting a VR headset to a front panel-based output.

Who Should Apply: Enthusiasts and gamers who want the best the GeForce GTX 1080 Ti has to offer.

Base/boost clocks: 1,632MHz/1,746MHz

Memory type/speed: 11GB GDDR5X, 11,448MHz

Display connectors: 1 HDMI, 3 DisplayPort, 1 DVI-D



MSI GeForce GTX 1060 GAMING X+ 6G

\$349.99

us.msi.com

Why You'll Dig It: MSI's Twin Frozr VI cooler is a wonderful addition to NVIDIA's Pascal cards. The graphics card's nickel-plated heatsink makes direct contact with the GPU die surface, and a combination of 6mm and 8mm heatpipes resides above the baseplate to efficiently transfer heat away. The open air cooler allows MSI to include an OC Mode with a 1,594MHz base clock and 1,809MHz boost clock, well above the 1060's stock 1,506/1,708 speeds. MSI is also able to pump up the memory clock to 9,126MHz. The "6G" in the product title showcases that this GTX 1060 features 6GB of GDDR5 memory, double what you see in many GTX 1060s. With ZeroFrozr technology, MSI configures the fans to remain idle when the GPU is running at cooler than 60 degrees Celsius.

Who Should Apply: Builders who want a powerful GTX 1060 that's also cool and quiet.

Base/boost clocks: 1,594MHz/1,809MHz

Memory type/speed: 6GB GDDR5, 9,126MHz

Display connectors: 1 HDMI, 3 DisplayPort, 1 DVI-D



SAPPHIRE NITRO+ Radeon RX 580 8GB

\$309.99

www.sapphiretech.com

Why You'll Dig It: The NITRO+ Radeon RX 580 8GB comes with SAPHIRE's Dual-X heatsink with four nickel-plated copper heatpipes and the heatsink is stamped to the shape of the MOSFET for optimal heat removal. Two black 95mm dual ball-bearing fans with a customized airflow provide powerful cooling, while also reducing noise. All told, SAPHIRE says the new cooler lets the card run up to 12dba quieter than the cooler on the 400 Series NITRO+ cards. SAPHIRE designs the NITRO+ Radeon RX 580 8GB with a 1,411MHz core clock, and in order to feed this card with enough juice for its high-speed clock, there are 8-pin and 6-pin PCIe power ports on the the card. Display outputs on the back bracket include two HDMI, two DP, and one DVI port.

Who Should Apply: Enthusiasts who want an affordable way to play games at 1440p.

Core clock: 1,411MHz

Memory type/speed: 8GB GDDR5, 8,000MHz

Display connectors: 2 HDMI, 2 DisplayPort, 1 DVI-D



EVGA GeForce GTX 1080 Ti FTW3 GAMING

\$799.99

www.evga.com

Why You'll Dig It: The new iCX cooler attached to EVGA's GeForce GTX 1080 Ti FTW3 GAMING is a dramatic departure from the company's ACX 3.0 coolers. iCX consists of what looks like a single piece of metallic gray webbed metal surrounding a trio of 90mm fans, and we like that EVGA keeps the heatsink compact enough that it doesn't extend past the dual-slot bracket. There's a black aluminum backplate that shares the Founders Edition's split design, letting you remove either side for better cooling performance when running cards in SLI. The iCX cooler also boasts a series of thermal sensors and microcontrollers built onto the PCB that intelligently determine which of this graphics card's fans should spin, at what speed, and for how long. The iCX cooling lets EVGA push the core and boost clocks to 1,569MHz and 1,683MHz, respectively.

Who Should Apply: Gamers who want a high performance GTX 1080 Ti with superior build quality. EVGA's smart innovations and dual-slot design are big bonuses, too.

Base/boost clocks: 1,569MHz/1,683MHz

Memory type/speed: 11GB GDDR5X, 11,016MHz

Display connectors: 1 HDMI, 3 DisplayPort, 1 DVI-D



SAPPHIRE PULSE Radeon RX 560 4GD5

\$129.99

www.sapphiretech.com

Why You'll Dig It: The Radeon RX 560 is meant for gaming at 1080p and is available in 2GB or 4GB options. Sapphire's PULSE Radeon RX 560 comes with 4GB of GDDR5 and the card's boost frequency is increased from the stock 1,275MHz to 1,300MHz. The dual-slot card features an incredibly low power consumption of 90 watts and supports Radeon Chill—AMD's adaptive power saving technology. Quiet cooling technology keeps the GPU's fan from spinning when not under load. The PULSE Radeon RX 560 4GB5 is powered by a single 6-pin PCIe connector. SAPPHIRE designs the GPU with one HDMI, one DisplayPort, and one DVI-D connector. The RX 560 supports next-generation API display technologies, including HDR and Radeon FreeSync 2.

Who Should Apply: Budget builders who plan on gaming at 1080p.

Core clock: 1,300MHz

Memory type/speed: 4GB GDDR5, 7,000MHz

Display connectors: 1 HDMI, 1 DisplayPort, 1 DVI-D



GIGABYTE AORUS Radeon RX580 XTR 8G

\$399.99

www.aorus.com

Why You'll Dig It: GIGABYTE configures the RX580 XTR 8G with an OC Mode core clock set to 1,439MHz, though by default the GPU runs in the Gaming Mode with a 1,425MHz core clock. The GPU's hearty custom cooler includes a pair of 100mm fans and an overall card length of more than 10.5 inches. The two fans spin in opposite direction to more evenly distribute cool air over the heatsink. Portions of the 6+2 phase VRM and all of the memory chips get direct heatsink contact via metal plates and thermal pads. GIGABYTE also provides several RGB LEDs to let you customize the GPU's lighting. A brushed aluminum backplate with a copper patch under the GPU is also bolted to the back of the card for improved cooling and added rigidity. Power comes via 8-pin and 6-pin PCIe power connectors. Outputs include three DisplayPort, one HDMI, and one DVI-D.

Who Should Apply: Power users in the market for one of the fastest Radeon RX 580s.

Core clock: 1439MHz

Memory type/speed: 8GB GDDR5, 8,000MHz

Display connectors: 1 HDMI, 3 DisplayPort, 1 DVI-D



GIGABYTE AORUS GTX 1080 Gaming Box

\$699.99

www.aorus.com

Why You'll Dig It: The AORUS GTX 1080 Gaming Box is an external GPU that connects to a PC via Thunderbolt 3, and it's ideal for improving the gaming capabilities of modern notebooks with a Thunderbolt 3 port. The embedded GPU is, of course, a GeForce GTX 1080 with a base clock of 1,632MHz and a boost clock of 1,771MHz. GIGABYTE includes a nearly 20-inch Thunderbolt 3 cable, as well as a power cord to supply the GPU with the juice it needs. When you need the notebook to be mobile or for productivity away from your desk, you can simply unplug the Thunderbolt 3 cable and the notebook will use its onboard graphics. The AORUS GTX 1080 Gaming Box also features three USB 3.0 ports, so you can connect a mouse, keyboard, and USB headset (or other USB device) to the unit.

Who Should Apply: Notebook owners (with a Thunderbolt 3 port) who want to massively increase gaming framerates.

Base/boost clocks: 1,632MHz/1,771MHz

Memory type/speed: 8GB GDDR5X, 10,010MHz

Display connectors: 1 HDMI, 3 DisplayPort, 1 DVI-D



MSI GeForce GTX 1080 Ti GAMING X TRIO

\$799

us.msi.com

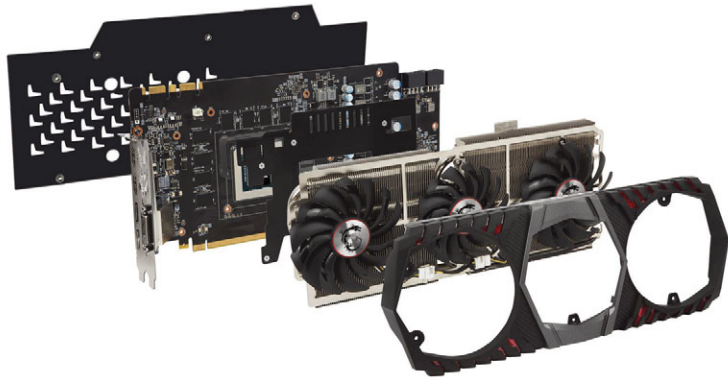
Why You'll Dig It: The GeForce GTX 1080 Ti GAMING X TRIO features three TORX 2.0 fans (two 100mm, one 92mm) with "dispersion blades" designed to accelerate airflow without increasing noise output. MSI estimates that the TORX 2.0 fans deliver 22% more air pressure than previous generation fans. The custom cooler comes with a nickel-plated baseplate to cool the GPU die and memory, as well as a weld-in MOSFET heatsink to reduce heat on the key power handling elements. The GeForce GTX 1080 Ti GAMING X TRIO also includes 10 phase, PWM design to spread out the card's voltage and reduce power draw fluctuations. It should come as no surprise that this GPU is meant for overclocking. MSI equips the GeForce GTX 1080 Ti GAMING X TRIO with a factory overclocked (in OC mode) 1,569MHz base clock and 1,683MHz boost clock.

Who Should Apply: Enthusiasts who want a cool, yet factory overclocked, GeForce GTX 1080 Ti.

Base/boost clocks: 1,569MHz/1,683MHz

Memory type/speed: 11GB GDDR5X, 11,124MHz

Display connectors: 2 HDMI, 2 DisplayPort, 1 DVI-D



MSI Radeon RX 570 GAMING X 8G

\$269.99

us.msi.com

Why You'll Dig It: AMD's RX 570 reference design calls for base and boost clocks of 1,168MHz and 1,244MHz, respectively. MSI's substantial cooler and custom seven-phase VRM-based PCB give the GPU a lot more space to run wild, however, so the OC Mode clock (enabled via the MSI Gaming App) can boost the core to up to 1,293MHz and the memory clock to up to 7,100MHz. On this slightly slimmed down version of the Twin Frozr VI cooler, you'll find one 8mm and one 6mm heatpipe that converge over a copper plate on top of the GPU's heatspreader, and both the heatpipes and copper plate sport a nickel-plated finish. There's no backplate or PCB face plate like on MSI's higher-powered cards, but the same red and black heatsink shroud with red LED highlights is here and an RGB MSI dragon logo adds some extra visual appeal.

Who Should Apply: If you're looking to max out the settings on all of your games at 1080p, the MSI Radeon RX 570 GAMING X 8G will more than get you there.

Core clock: 1,293MHz

Memory type/speed: 8GB GDDR5, 7,100MHz

Display connectors: 2 HDMI, 2 DisplayPort, 1 DVI-D



XFX AMD Radeon RX 580 GTS Black Core Edition 8GB

\$339.99

www.xfxforce.com

Why You'll Dig It: In order to maintain the maximum performance in all possible scenarios—not just during demanding gameplay—XFX applies its True Clock technology that controls the core clock with the BIOS. On the AMD Radeon RX 580 GTS Black Core Edition 8GB, the GPU features a 1,386MHz True Clock speed, well above AMD's 1,257MHz reference design. XFX also supports dynamic clock speeds up to 1,405MHz in an OC mode you set up using AMD's Wattman utility. Lending a helping hand in that dynamite clock speed is XFX's High Performance Unibody Heatsink, which uses a hefty block of copper and copper heatpipes to quickly draw heat from the surface of the GPU. The card's VRM and memory chips also get some improved cooling tech, which results in a VRM that's up to 30 degrees cooler and GDDR5 chips that are up to 20 degrees cooler (Celsius).

Who Should Apply: Builders who want an impressively cooled, high-performance Radeon RX 580.

Core clock: 1,405MHz

Memory type/speed: 8GB GDDR5, 8,100MHz

Display connectors: 1 HDMI, 3 DisplayPort, 1 DVI-D



ZOTAC GeForce GTX 1060 3GB

\$249.99

www.zotac.com

Why You'll Dig It: The 6.85-inch long ZOTAC GeForce GTX 1060 3GB is excellent for small form factor gaming builds, and the GP106 GPU at the heart of the GTX 1060 is manufactured using the same 16nm FinFET process as the rest of the Pascal GPUs that ship on NVIDIA's 10 Series graphics cards. The GTX 1060 also features 1152 CUDA cores, and this model comes with 3GB of GDDR5 memory clocked at 8,000MHz (effective). For sufficient cooling, ZOTAC installs a custom designed aluminum heat sink with heat pipes that make direct contact with the GPU. The card's 90mm fan disperses heat from the GPU and heatsink. ZOTAC's GeForce GTX 1060 3GB is also VR Ready and supports NVIDIA's VRWorks technology to drive VR audio, physics, and haptics.

Who Should Apply: Gamers who play at 1080p and want consistently good framerates at maximum settings.

Base/boost clocks: 1,506MHz/1,708MHz

Memory type/speed: 3GB GDDR5, 8,000MHz

Display connectors: 1 HDMI, 3 DisplayPort, 1 DVI-D



AMD Radeon RX Vega 64

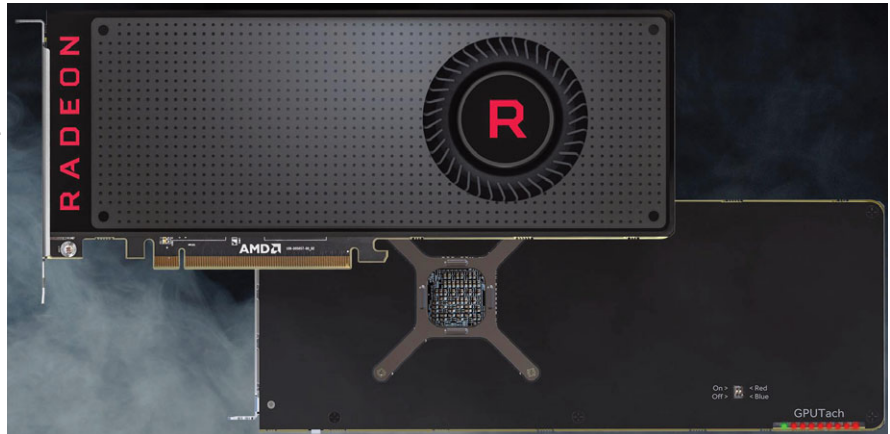
\$499.99

www.amd.com

Why You'll Dig It: The RX Vega 64 features the fifth generation GCN (Graphics Core Next) architecture, which consists of Next-Generation Compute Units—64 to be exact. Compared to 4th Gen GCN, these GPUs were built to support higher IPC (instructions per clock), support for HBM2 (High Bandwidth Memory 2), and faster clock speeds. As a reference card, this GPU comes with base and boost clocks set to 1,247MHz and 1,546MHz, respectively. AMD also uses the Infinity Fabric backbone from its Ryzen Threadripper processors to connect the Vega die and 8GB of HBM2 memory, which is clocked at 1,890MHz. And with HBM2's 2048-bit memory bus, the card's memory bandwidth is an impressive 483.8GBps. The reference Radeon RX Vega 64 boasts three DisplayPort outputs and one HDMI port.

Who Should Apply: Power users who want the best AMD GPU currently available.

Base/boost clocks: 1,247MHz/1,546MHz
Memory type/speed: 8GB HBM2, 1,890MHz
Display connectors: 1 HDMI, 3 DisplayPort



ZOTAC GeForce GTX 1080 Mini

\$534.99

www.zotac.com

Why You'll Dig It: At only 8.3-inches long, ZOTAC's GeForce GTX 1080 Mini is a high performance GPU that will fit in almost any rig, including the majority of Mini-ITX builds. To deal with the heat of the 1080, ZOTAC uses its ICESTORM cooler featuring a 90mm and a 100mm fan on top of a heatsink with two blocks of aluminum fins and five 6mm copper heatpipes. The wide heatsink array maximizes airflow over the compact cooling system. In addition to the LED accents on the shroud, there's an LED-lit ZOTAC logo on the top edge of the card. With the company's FIRESTORM utility, you can tweak the RGB LEDs to look and perform exactly how you want them to. FIRESTORM also lets you monitor GPU functions, such as voltage and temperature.

Who Should Apply: Small form factor builders who want Pascal GTX 1080 power.

Base/boost clocks: 1,620MHz/1,759MHz
Memory type/speed: 8GB GDDR5X, 10,000MHz
Display connectors: 1 HDMI, 3 DisplayPort, 1 DVI-D



ASUS ROG STRIX GTX1050TI O4G GAMING

\$184.99

www.asus.com

Why You'll Dig It: NVIDIA's 1050 Ti is a good value for gamers who play at 1080p. On this GPU, ASUS provides an OC mode that jumps NVIDIA's 1050 Ti to a base clock of 1,392MHz (up from 1,290MHz at stock settings) and boost clock of 1,506MHz (up from 1,392 at stock settings). The overlocks allow you to play modern games at 60fps at a more affordable price than the GeForce GTX 1060. Similar to ASUS' high-end STRIX GPUs, the ROG STRIX GTX1050TI O4G GAMING boasts DirectCU II Technology with heatpipes that make contact with the GPU die to efficiently move heat, instead of relying on the more traditional cooler design that slips a polished piece of nickel-plated aluminum between the two. The 1050 Ti boasts 4GB of memory that operates at 7,008MHz, and the relatively high VRAM capacity helps to maintain framerates when gaming at 1080p and higher settings.

Who Should Apply: Mainstream gamers who want to strike a balance between gaming performance and affordability.

Base/boost clocks: 1,392MHz/1,506MHz

Memory type/speed: 4GB GDDR5, 7,008MHz

Display connectors: 1 HDMI, 1 DisplayPort, 2 DVI-D



PNY GeForce GTX 1080 XLR8 Gaming OC

\$599.99

www.pny.com

Why You'll Dig It: Can't afford NVIDIA's 1080 Ti, but still want premium Pascal power? PNY puts its Triple Fan XLR8 cooler to work and factory overlocks the GPU with a 1,708MHz base clock (up from 1,607MHz stock) and a 1,848MHz boost clock (up from 1,733MHz stock). PNY backs up the overclocked GPU with a three-year warranty. The GeForce GTX 1080 XL8 Gaming OC is 12 inches long and fits into a dual-slot bracket. Under the hood, there are four 6mm copper heatpipes that disperse heat across the long fin array. To make this long GPU sturdy and further improve cooling capacity, PNY installs an anodized full length backplate. Video outputs include three DisplayPort 1.4 ports, an HDMI 2.0b port, and a DVI-D port.

Who Should Apply: 4K gamers looking for a GPU that will dominate for years to come.

Base/boost clocks: 1,708MHz/1,848MHz

Memory type/speed: 8GB GDDR5X, 10,000MHz

Display connectors: 1 HDMI, 3 DisplayPort, 1 DVI-D



EVGA GeForce GTX 1070 FTW GAMING ACX 3.0

\$479.99

www.evga.com

Why You'll Dig It: EVGA is not about to put a stock clocked GPU into its FTW model; the AIB card maker raised the base clock from 1,506MHz to 1,607MHz, and the boost clock went from 1,683MHz to 1,797MHz. The cooler on this card features a pair of 95mm double ball bearing fans surrounded by a matte black heatsink shroud. There are four brushed aluminum plates bolted onto the heatsink shroud, one at each corner. The underlying heatsink relies on a series of nickel-plated heatpipes running through a bank of aluminum fins, and the PCB is sandwiched between two rigid aluminum plates, making this card feel really solid and particularly heavy. EVGA says the plate on the GPU side of the PCB reduces the temps of the memory chips and GPU MOSFETs by 15% and 13%, respectively.

Who Should Apply: Power users who want a well-designed GTX 1070 that will handle the rigors of all-day gaming.

Base/boost clocks: 1,607MHz/1,797MHz

Memory type/speed: 8GB GDDR5, 8,008MHz

Display connectors: 1 HDMI, 3 DisplayPort, 1 DVI-D



ASUS ROG POSEIDON GTX1080Ti P11G GAMING

\$859.99

www.asus.com

Why You'll Dig It: ASUS has taken a bold approach with its ROG POSEIDON GTX1080Ti P11G GAMING, installing an air cooler that doubles as a built-in waterblock. A pair of G 1/4 threaded fittings allow you to install your choice of barbs, while the inner U-shaped liquid channel transfers heat from a copper vapor chamber. If you're not quite ready to incorporate the GPU into a liquid cooling loop, you can use the built-in air cooling shroud. The hybrid liquid/air cooler isn't the only souped-up aspect of this graphics card. ASUS gave the GPU its Super Alloy Power II treatment that's designed to be 50% cooler than previous designs. ASUS' GPU Tweak II utility lets you overclock the GPU with a single click, and there's an OC mode to push the GTX 1080 Ti's base clock to 1,602MHz and boost clock to 1,733MHz.

Who Should Apply: Enthusiasts who want to liquid-cool the GTX 1080 Ti and don't want to install an aftermarket waterblock and void the GPU's warranty.

Base/boost clocks: 1,620MHz/1,733MHz

Memory type/speed: 11GB GDDR5X, 11,100MHz

Display connectors: 2 HDMI, 2 DisplayPort, 1 DVI-D

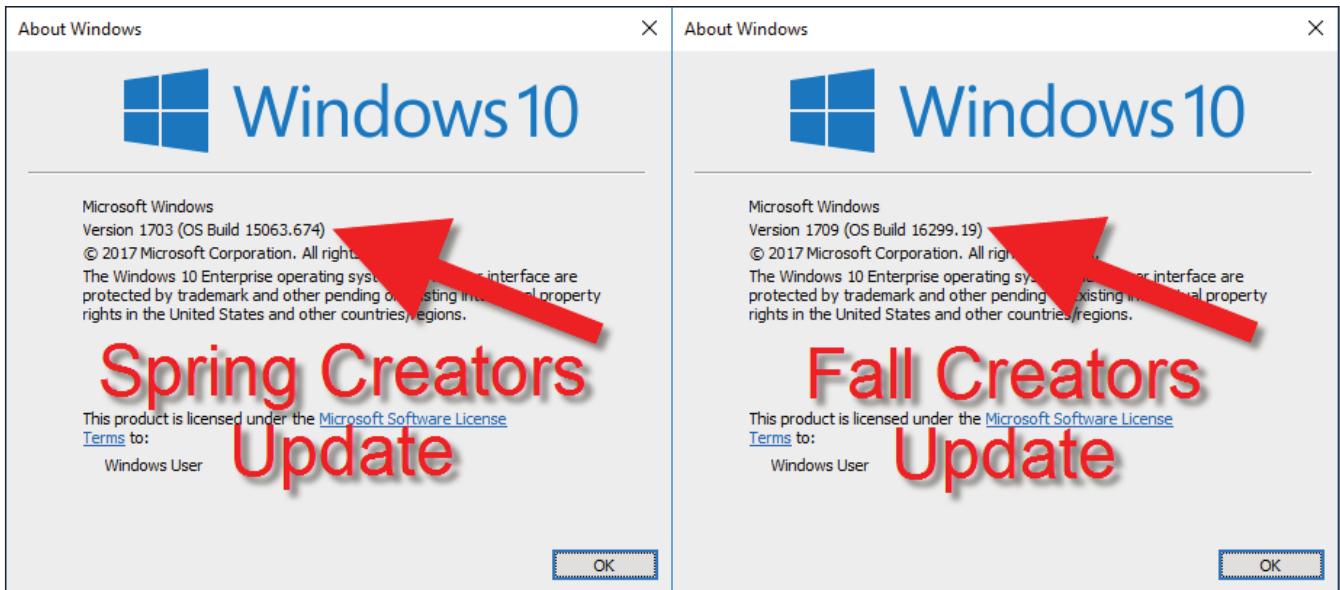


GRAPHICS CARD COMPARISON CHART

BUYER'S GUIDE

Graphics Card	MSRP	Core/ Boost Clock	Effective Memory Clock	Memory	Display Connectors	Power Inputs	Length (inches)
GIGABYTE AORUS GeForce GTX 1080 Ti Extreme Edition 11G	\$879.99	1,632MHz/ 1,746MHz	11,448MHz	11GB GDDR5X	1 HDMI, 3 DisplayPort, 1 DVI-D	2 8-pin	11.54
ASUS ROG POSEIDON GTX1080TI P11G GAMING	\$859.99	1,620MHz/ 1,733MHz	11,100MHz	11GB GDDR5X	2 HDMI, 2 DisplayPort, 1 DVI-D	2 8-pin	11.73
MSI GeForce GTX 1080 Ti GAMING X TRIO	\$799.99	1,569MHz/ 1,683MHz	11,124MHz	11GB GDDR5X	2 HDMI, 2 DisplayPort, 1 DVI-D	2 8-pin	12.8
EVGA GeForce GTX 1080 Ti FTW3 GAMING	\$799.99	1,569MHz/ 1,683MHz	11,016MHz	11GB GDDR5X	1 HDMI, 3 DisplayPort, 1 DVI-D	2 8-pin	11.8
GIGABYTE AORUS GTX 1080 Gaming Box	\$699.99	1,632MHz/ 1,771MHz	10,010MHz	8GB GDDR5X	1 HDMI, 3 DisplayPort, 1 DVI-D	External power cord	External GPU
NVIDIA GeForce GTX 1080 Ti Founders Edition	\$699.99	1,480MHz/ 1,582MHz	11,010MHz	11GB GDDR5X	1 HDMI, 3 DisplayPort	1 8-pin, 1 6-pin	10.5
PNY GeForce GTX 1080 XLR8 Gaming OC	\$599.99	1,708MHz/ 1,848MHz	10,000MHz	8GB GDDR5X	1 HDMI, 3 DisplayPort, 1 DVI-D	1 8-pin	12
ZOTAC GeForce GTX 1080 Mini	\$534.99	1,620MHz/ 1,759MHz	10,000MHz	8GB GDDR5X	1 HDMI, 3 DisplayPort, 1 DVI-D	1 8-pin	8.31
AMD Radeon RX Vega 64	\$499.99	1,247MHz/ 1,546MHz	1,890MHz	8GB HBM2	1 HDMI, 3 DisplayPort	2 8-pin	11.03
EVGA GeForce GTX 1070 FTW GAMING ACX 3.0	\$479.99	1,607MHz/ 1,797MHz	8,008MHz	8GB GDDR5	1 HDMI, 3 DisplayPort, 1 DVI-D	2 8-pin	10.5
MSI GeForce GTX 1060 GAMING X+ 6G	\$349.99	1,594MHz/ 1,809MHz	9,126MHz	6GB GDDR5	1 HDMI, 3 DisplayPort, 1 DVI-D	1 8-pin	10.91
XFX AMD Radeon RX 580 GTS Black Core Edition 8GB	\$339.99	1,405MHz	8,100MHz	8GB GDDR5	1 HDMI, 3 DisplayPort, 1 DVI-D	1 8-pin	10.63
GIGABYTE AORUS Radeon RX580 XTR 8G	\$309.99	1439MHz	8,000MHz	8GB GDDR5	1 HDMI, 3 DisplayPort, 1 DVI-D	1 8-pin, 1 6-pin	10.85
SAPPHIRE NITRO+ Radeon RX 580 8GB	\$309.99	1,411MHz	8,000MHz	8GB GDDR5	2 HDMI, 2 DisplayPort, 1 DVI-D	1 8-pin, 1 6-pin	10.24
MSI Radeon RX 570 GAMING X 8G	\$269.99	1,293MHz	7,100MHz	8GB GDDR5	2 HDMI, 2 DisplayPort, 1 DVI-D	1 8-pin	10.87
ZOTAC GeForce GTX 1060 3GB	\$249.99	1,506MHz/ 1,708MHz	8,000MHz	3GB GDDR5	1 HDMI, 3 DisplayPort, 1 DVI-D	1 6-pin	6.85
ASUS ROG STRIX GTX1050TI O4G GAMING	\$184.99	1,392MHz/ 1,506MHz	7,008MHz	4GB GDDR5	1 HDMI, 1 DisplayPort, 2 DVI-D	1 6-pin	9.5
SAPPHIRE PULSE Radeon RX 560 4GD5	\$129.99	1,300MHz	7,000MHz	4GB GDDR5	1 HDMI, 1 DisplayPort, 1 DVI-D	1 6-pin	8.27

Windows 10 Creators Update



For Microsoft's Windows 10, 2017 is apparently the Year Of The Creator.

Back in March, we took a look at one of the marquee features of the Windows Creators Update, codenamed Redstone 2, which was due to begin rolling out in the Spring. Windows 10 Game Mode effectively makes the games you play (regardless of whether you bought them on Steam, GOG, the Windows Store, a brick and mortar retail store, or anywhere else) the top priority when it comes to doling out access to hardware resources. The Creators Update was the third major update released for Windows 10, and although Game Mode didn't exactly blow us away, any performance improvement for our gaming systems is appreciated.

There are a number of other features introduced earlier this year in this update including Microsoft's Cortana digital assistant, a picture-in-picture mode for the Movies & TV app, a blue light filter called Night Light, the Dynamic Lock feature

that automatically locks your Win10 PC when you're no longer in its vicinity, Paint 3D, and support inking on photos. The original Creators Update also improved Microsoft Edge in a number of ways, made Windows Hello's automatic login-process quicker, and let users take greater control over how they get updates and guard their privacy. In that article, we gave you some strategies for downloading the Creators Update as soon as it became available, but by now you should be running it.

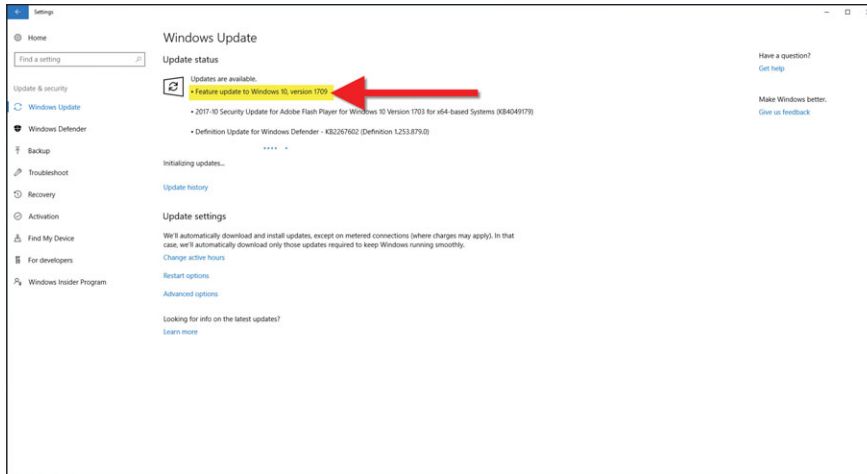
Windows 10 Fall Creators Update

Microsoft seems to be crushing hard on creators lately; the next Windows 10 update, codenamed Redstone 3, is being referred to as the Fall Creators Update. However, as we'll reveal in this article, there's a lot to love in the new features regardless of what you use your Windows 10 PC for.

UI Candy

Many of the user interface changes that you may or may not immediately notice once running the Fall Creators Update are a part of Microsoft's "Fluent Design" philosophy. We were talking about Fluent Design all the way back when Office 2007 introduced the ribbon toolbar, but trying to define what it really means is a little difficult. You can visit <https://fluent.microsoft.com/> and watch a very hypnotic video about Fluent Design, and while it doesn't exactly spell out what it means, the video does succeed in showing you how many of Microsoft's products have been infused with elements of the design philosophy, including the Surface tablets, Xbox consoles and peripherals, other hardware devices, software interfaces, and more.

The basics of Fluent Design boil down to using light, depth, motion,



When the Fall Creators Update arrives in your Windows Update queue, this is what it'll look like.

The Fall Feature Rundown

Aside from the visual enhancements, there are a number of new features that come bundled into the new update. One of the big ones is the new People hub, pinned to the taskbar, next to the System Tray. Click the People icon to pin contacts to this spot on the taskbar, so you can quickly initiate Skype conversations and file sharing, and begin composing emails. You can add up to three pinned contacts here, and these favorite contacts can send Skype emojis that'll appear right on your Desktop. When you click the emoji, you'll dive right into the Skype conversation. The People hub also lets you quickly connect to a contact via certain apps, such as Skype, Mail, and People, though there will be a selection of third-party apps that integrate nicely as well.

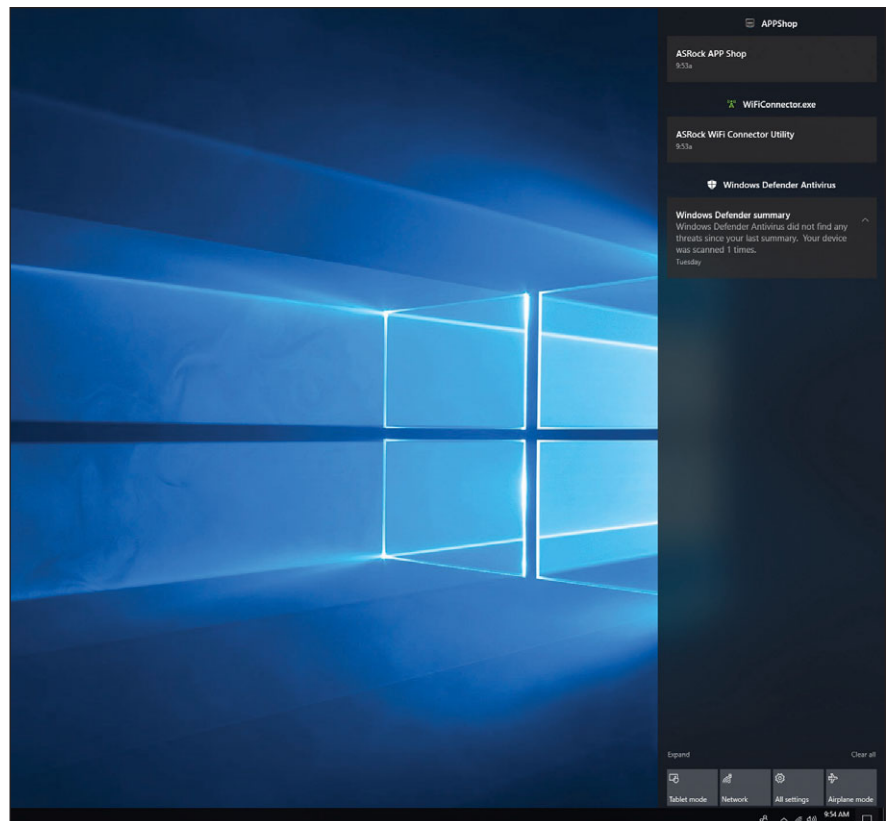
The Share button that appears in Edge and other first-party Microsoft apps now lets you tap into more features, including

material, and shifting scale, combined with intuitive layouts, to create a UI that's easy to navigate and pleasing to the eye. Color and typography are two more elements that form the backbone of the new scheme, and there are several places in the Fall Creators Update version of Windows 10 where these design elements become evident. Two new effects you'll notice throughout are a parallax effect and a frosted acrylic appearance, where windows and toolbars reveal colors and blurred impressions of your wallpaper through certain portions of the window.

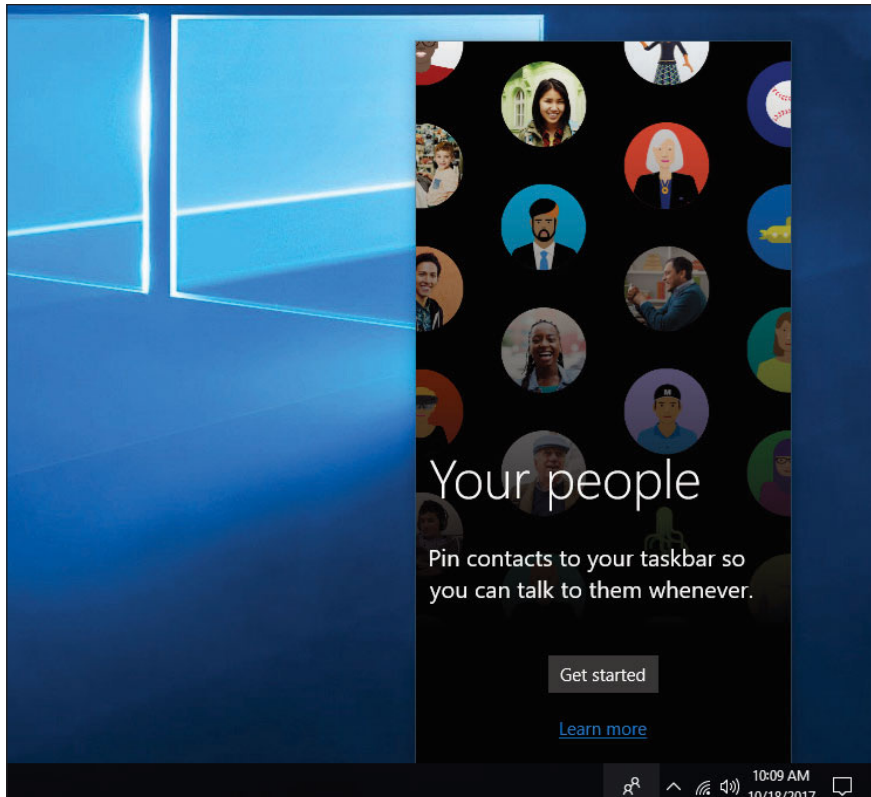
The Action Center, for one, is the sidebar docked to the right side of the screen that appears when you click the notifications icon from the system tray. After the update, you'll notice that notifications float inside the panel, instead of being attached to the right side of the screen. When a notification first pops, it too appears unattached to the right side of the screen.

Various apps and menus now support what's called a reveal effect, which shows a highlighted area around your cursor as you move it around the UI and menus. When you click something, there's a subtle halo of light that shrinks and expands as you click, just before the item activates. This is an example of how Microsoft's developers are using light to draw attention to your current focus. You may also notice a slight

blurring of window contents and text when moving and dragging certain first-party app windows.



The Action Center gets a number of new features and UI tweaks.



The People app now lets you more easily connect with your favorite contacts, via pinned icons on the taskbar.

a list of your pinned contacts at the top, access to other contacts, and more. This lets you quickly send links and files to people without having to manually save the item to your PC, launch the communication app, and attach it before sending it off.

OneDrive is also getting a pretty large overhaul in the Fall Creators Update. Now you can view all files stored in the cloud on your OneDrive without having to actually have them synced to your machine. When you go into your OneDrive folder, there's a new Status detail column along the top edge of the folder that shows up to the right of the Name column. This displays a blue cloud icon for any item not synced to your system, and a green checkmark for items that are. Any item with a cloud icon will not be available if you're offline, and obviously, these items will also need to download to your local system when you want to access them. You can set any OneDrive item saved locally to cloud status, effectively deleting

it from the local machine, by right-clicking it and clicking Free Up Space. The right-click context menu in OneDrive also has an Always Keep On This Device option, which changes the checkmark to a bold green checkmark.

Story Remix, a new feature built into the Photos app, lets you click the Create button from the top of the window to access Video Remix (view and edit a video made for you), Video Project (edit a new video from start to finish), and Album (gather related photos and videos). If you choose the Video Remix option, you'll get a list of images and videos from your libraries, and you can add checkmarks to any that you want included. After clicking Add, the utility will automatically mix them, add music, and let you view the finished result. If you're not happy with the video, click the Remix It For Me button to scramble the order of the media and substitute in a new music selection. If you

like the finished product, you can click Export the Results, or take over complete control by clicking the Edit Video button. Here, you can manually choose clip order, music selections, style, and even add text. When exporting video, you'll have three options, S (small), M (medium), and L (large), which are best suited to quick upload and small screens, sharing online, and big screens, respectively.

Timeline is a new feature that tracks when you were working with various apps and sites and lets you quickly see a timeline of your computing activity so you can pick up where you left off almost instantly, whether it was yesterday, or six months ago.

Odds & Ends

In Edge, if you press the Windows Key and the Semicolon key, you'll open a dedicated emoji panel, letting you add emojis into any currently active text field. For the folks who use a touch-screen Windows 10 device, there's now a Swype keyboard that lets you drag your finger between letters to type words quickly. Another touch-friendly feature that made its way into the Fall Update is the ability to scroll any portion of the UI or a webpage using a pen, instead of having to straddle the edge of a window to find the narrow scroll bar.

Task Manager now supports a GPU activity category. When you press CTRL+ALT+DELETE, click Task Manager, and click More Details, you can now click the Performance tab and see a thumbnail at the bottom for your discrete or integrated GPU. Click it from the left side of the Task Manager to see 3D, Copy, Video Decode, Video Processing, and Shared GPU Memory Usage activity bars, updating in real-time. You can also see driver version, driver date, supported DirectX version, and physical location of each GPU in this window.

Microsoft Edge has gotten some tweaks as well. The Favorites Hub now lets you quickly arrange where your favorites are stored or create new folders to keep them organized. You can also navigate to websites and pin them to the taskbar just like you do with frequently used apps.

Just navigate to the page you want to pin, click the three horizontal dots icon from the top-right corner of the Edge UI, and then click Pin This Page To The Taskbar.

Edge also supports linking directly onto PDFs that have been loaded into the browser. Furthermore, the PDF reader built into Edge supports a new read aloud accessibility function. Just right-click and select Read Aloud and the text onscreen will be read aloud. This also works for most web pages. Overall, Edge has gotten a number of improvements that make it faster and more reliable.

Settings Gets Some Love

One of our favorite places in Windows 10, the Settings app, has also gotten a number of improvements with the Fall Creators update. First off is the Phone app, which lets you link your Android or iPhone device to your Windows PC to swap webpages and media between the two devices. Cortana also now gets a dedicated app in the Settings menu, which lets you tap into all of the digital assistant's functions and switches.

You can also access a new Video Playback item from the Settings app that lets you optimize your viewing experience depending on how you use your PC. For instance, you can enable or disable HDR Streaming if you have a compatible monitor, automatically enhance video, allow low-resolution playback for bandwidth-constrained situations, toggle between optimizing video playback for maximum battery life or for the best video quality while unplugged, and more.

The System icon in the Settings app now features a more options for Storage Sense, which—when enabled—lets your system more aggressively free up space when you're running low.

Windows Update is also getting a slight modification. Now, the utility can determine what you're doing on the PC and tailor how updates are downloaded and installed to minimize the impact on your computing experience. For instance, if you're streaming a video, the system will ensure you have enough bandwidth to continue watching the video as it begins

downloading updates in the background. Clicking the Advanced Options item from the Windows Update screen lets you click Delivery Optimization to really take control over how Windows handles update downloading in the background.

The Ease Of Access menu item in the Settings app now supports a variety of color filters, letting you improve readability to accommodate for various types of color blindness or just personal preferences.

The Mixed Reality Viewer is a fun little feature that lets mobile Windows users drop fully rendered items and creatures onto real-world objects, like your desk or keyboard. You can move the devices around, and the 3D object appears as though it's pinned to the spot.

How To Get The Windows 10 Fall Update

Now that you're stoked to experience a few of the update's new features, you're probably wondering how exactly you get it. According to Microsoft, as long as Automatic Updates are enabled, your Windows 10 system should download and install the Fall update in the background. To make sure your system is primed, click Start, Settings, Update & Security, then click Check For Updates.

Unlike the Anniversary Update (1607) and the Spring Creators Update (1703),

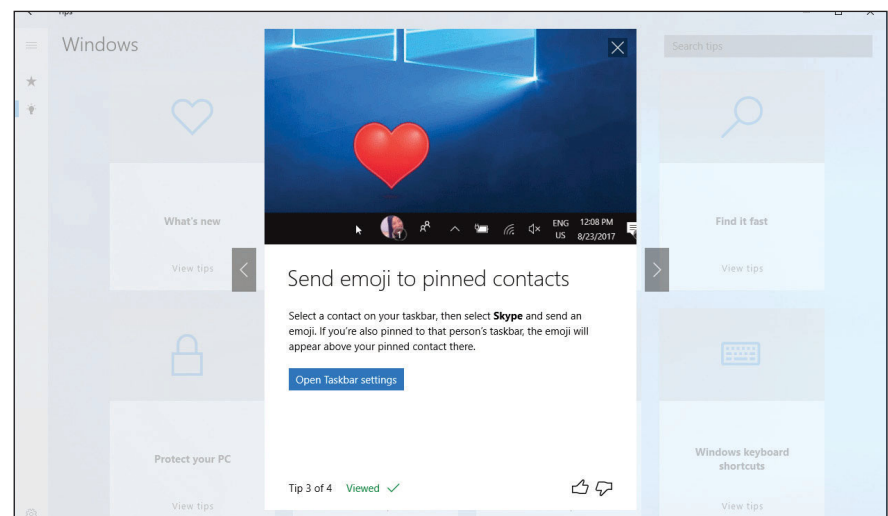
the Fall Creators Update doesn't herald its arrival with windows showing off a few of its most notable features, so there's a chance you have it installed and didn't even know it.

To quickly determine which version of Windows 10 you're using, click into the Search box by the Start button and type winver, then press ENTER. You can also access this information by clicking Start, Settings, System, and then About. Version 1709, designated the Fall Creators Update, is what you're looking for. If you have anything prior to 1709, then visit <http://bit.ly/1Sf99Cx> and click the Update Now button. When the update finishes downloading, just launch it and follow the instructions to complete the operation.

What's In Store For Redstone 4?

Although a vast majority of those reading this will be new to the features in version 1709, Microsoft is busy working on the next series of updates for the as-yet unnamed update, likely scheduled for some time in the first half of 2018.

Starting in late August, Microsoft began seeding tweaks to the Fall Creators Update to Microsoft Insiders. For the most part, these updates have been centered on bug fixes or minor tweaks to current features, such as a fix for DPI mismatch errors that occur when unplugging an external



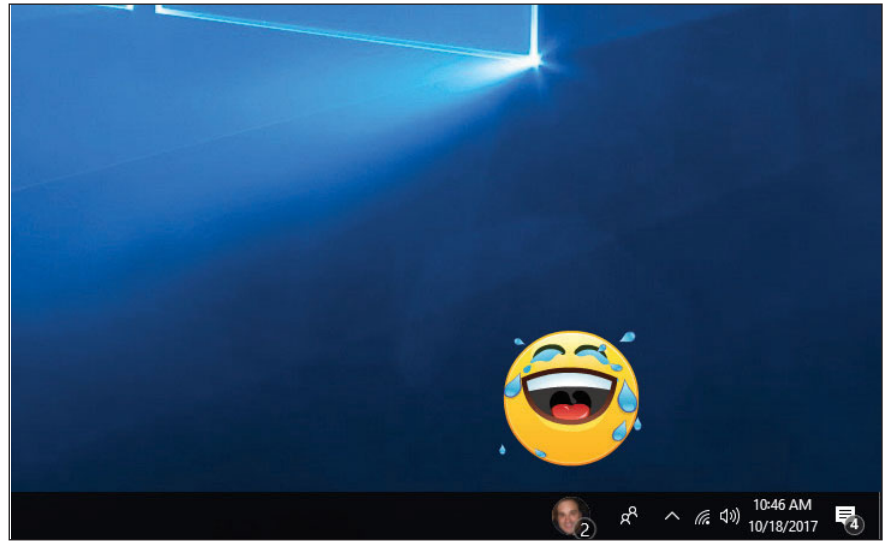
Pinned contacts that send you emojis in Skype conversations have a new way to get your attention.

monitor, lock screen customizations via Cortana, additional Fluent Design elements making their way into the UI, lists of things you might commonly look for organized into “Cortana Collections,” and a fix for a time zone switching problem that could only be resolved after logging off then back on.

Update Fever

If getting in on Microsoft Insider preview builds is something you’d like to look into, look no further. To join the Windows Insider Program, visit <https://insider.windows.com> and click the Register Your Personal Account button. As long as you’re ok with software that may lack polish and, more critically, stability, sign-in with your Microsoft account and proceed.

Once you’re a legitimate Insider, make sure your system is fully up-to-date (it’s helpful to have Automatic Updates enabled). Next, click the Start button, Settings, Update & Security, and then click Windows Insider Program, located at the bottom left corner of the window. If your Windows Insider account is already linked to your Win10 profile, you can click the Get Started button under the Get Insider Preview Builds heading. If not, click the Link A Microsoft Account button to activate the preview builds button, and click it when you’re finished.

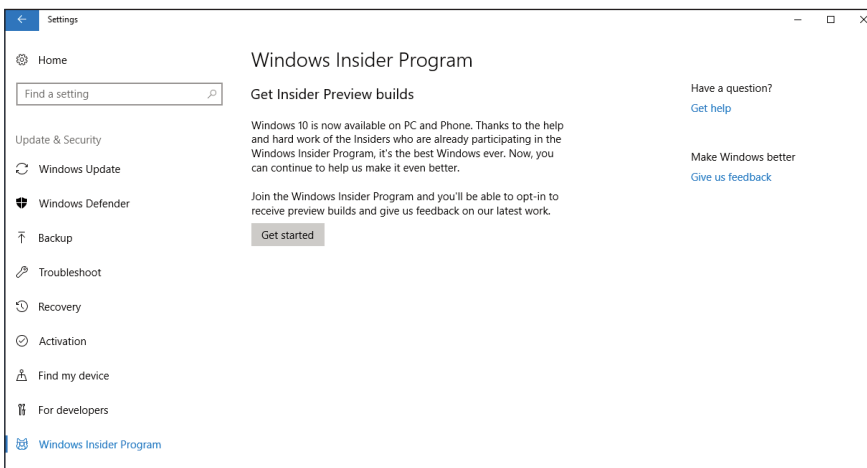


On second thought, maybe don’t pin contacts that are likely to send you an endless stream of animated emojis.

Before you install a preview build, you’ll be faced with a strongly worded warning about the possible need to reinstall Windows from scratch. If you’re ready to install the latest preview builds, click the Next button and then click Confirm to acknowledge that you are aware that a reinstall may be required if you want to remove a Preview Build from your PC. Then restart your PC by clicking the appropriate button.

If you’re following along, you need to return to the Settings, Update & Security, Windows Insider Program screen. There will be a dropdown box below the Choose Your Insider Level, which you can use to select the Fast, Slow, or Release Preview Ring. Selecting the Fast Ring is for PC experts only and results in newer features sooner, but you shouldn’t be surprised that there’s also a greater risk you’ll encounter bugs, inconvenient quirks, and system killing issues. The Slow Ring provides minimal risk to your installation, and the Release Preview Ring installs only updates for the current branch. This lattermost option is the default setting. We recommend the Slow Ring for all but the most advanced users who have no problem working around buggy software and have multiple backup systems.

After making your selection, Microsoft reports that a background process will launch to check your system compatibility and register it with the company’s release system. It might take as many as 24 hours for the updates for your selected ring to arrive. On the Update & Security screen, click Windows Update, and then click Check For Updates, let them install and restart your computer when prompted. ■



If you want to get in on a steady stream of updates and new features, sign up to be a Windows Insider and join the program.

Upgrades That'll Keep You Humming Along

Maybe it's still a little too early to declare traditional email the new snail mail, but a slew of upstart messaging and communication apps are doing what they can to put it out to pasture. If you're still behind the curve, worry not, but don't linger. Programs like Missive and Rambox aren't going to wait for you.

SOFTWARE UPDATES

BlackFog Privacy for Windows 3.1.0

Hackers have been on fire this year (not a good thing), whether that's the Equifax breach, WannaCry, or some other attack. Bottom line: Even though you can't always rely on third parties to keep your data secure, you should still do whatever you can to lock things down on your end. That's where BlackFog comes into the picture. The first big update since June's 3.0.0 release, version 3.1.0 boasts a graphical dashboard and the ability to remotely control the program's settings. You can also remotely lock some elements of the UI. The latest update also has the following pair of performance tweaks: improved memory usage and decreased CPU load.

www.blackfog.com

FreeFileSync 9.4

If you need to synchronize lots of files and folders, and you don't want to pay anything for the ability to do so, well, connect the dots. FreeFileSync goes well beyond syncing between local disks and folders, too, working its magic over network shares, on mobile devices (Android and iOS), and even cloud storage using SFTP. Version 9.4 is more of a maintenance update, but it nonetheless cleans up a lot of things. You should now be able to use VSS to copy files with locked byte ranges. The program will also support hash characters in FTP directory listings, and the Donation Edition has been repackaged to cut down on the likelihood that antivirus software returns a false positive when it scans the software.

www.freefilesync.org

Missive 4.1.0

Missive is designed to help your group win at communication. A minor update, version 4.1.0, comes a day after the version 4.0.0 release added a couple of cool new features. Specifically, Missive now supports Office 365, Outlook, iCloud, and IMAP, although this addition is still in beta according to the dev team. You can also mute notifications on a per-conversation basis and exclude individual conversations from your badge count. The 3.23.0 update at the end of September introduced even better goodies, such as live notifications for read tracking, label sorting, and granular Conversation List settings.

missiveapp.com

PostgreSQL 10

"The world's most advanced open-source database" turns 10 this month, and it's jam-packed with enough shiny new tools that we could fill an entire page and then some discussing them. Perhaps the most significant change is PostgreSQL 10's arms-wide-open embrace of the "divide and conquer" strategy—spreading data over multiple nodes. To that end, the new version includes a slew of tricks, such as native logical replication, declarative table partitioning, and improved query parallelism. Other standout additions are quorum commit for synchronous replication and SCRAM-SHA-256 authentication. If you're looking for a PostgreSQL 10 deep dive, check out the full release notes at goo.gl/Ktm3hh.

www.postgresql.org

Rambox 0.5.13

A cross-platform, FOSS messaging and email client that unifies all of our favorite

communication apps (as in, not just Slack and Skype but also Discord)? Yes, please. Rambox is compatible with these and many, many more. In version 0.5.13, Rambo makes the move to the latest stable release of Electron, version 1.7.8. Elsewhere, the new version makes minor improvements here and there, such as better Auth0 integration. Rambox also expands its already impressive list of supported services, adding Google Voice, Sandstorm, Gadu-Gadu, Mail.Ru, and Kune.

rambox.pro

YUMI 2.0.5.0

A favorite among Linux commandos for what feels like eons, YUMI (Your Universal Multiboot Installer) is one of the easiest and most trusted ways to put Linux on a USB flash drive; its menu of supported distros is massive, as well. In version 2.0.5.0, that menu grows a little longer. Now, YUMI supports Antergos, PureOS, CentOS Installer, Ubuntu Mini (using Netboot Installer), plus recent Debian Live and Tails Images. Additionally, the YUMI found and fixed a small handful of broken links, including Debian's home page and download links for Ubuntu and Xubuntu.

www.pendrivelinux.com

DRIVER BAY

NETGEAR R6300v2 Firmware 1.0.4.12

Owners of this 802.11ac dual-band router may want to install this new firmware, as it fixes "some security issues." The firmware also solves an issue that causes IPTV stream freezes when IGMP forwarding goes awry.

www.netgear.com/support

Cryptocurrency Grows Up

Bitcoin & Co. Go Beyond The Blockchain

Next year, Bitcoin will be one year away from its tenth birthday, and in its eight years of existence it has gone from whimsical pizza purchases to a legitimate economic force that governments and high-powered investment firms must recognize. Whether spending 10,000 Bitcoins (valued at \$57 million at the time of this writing) on a pair of pies was a joke at the time, one thing is crystal clear: Bitcoin and a handful of altcoins are no laughing matter.

Right now, the cryptocurrency of cryptocurrencies is riding high. Although Bitcoin's price had retreated slightly from its all-time high as we went to press, to say October was an exciting month would be an understatement. After passing the \$5,000 threshold, Bitcoin continued its furious climb, eclipsing the \$6,000 mark on Oct. 20. It's possible that this rampage won't last (markets tend to correct themselves, after all), but Bitcoin's steady rise since the end of 2015 suggests that even the most ardent cryptocurrency deniers will have a difficult time arguing against Bitcoin's continued presence in the global economy. We're way past quaint notions of Bitcoin existing solely as a reason for nerds to keep their PCs running full tilt 24-7.

Going forward, Bitcoin, along with altcoins like Ethereum, Ripple, Litecoin, and others (yes, Dogecoin, you can come, too), must contend with a host of factors beyond price fluctuations and other market trends. Some countries have ramped up regulatory efforts in order to have some measure of control over cryptocurrencies. Other governments have made strides to proactively integrate



Every now and then, you'll see the price chart of a hot stock look like a hockey stick, where the price suddenly shoots up. Over the full course of Bitcoin's existence, its 2017 surge looks more like a rocket launch. At the time of this writing, the granddaddy of cryptocurrencies had charged past \$6,000 while simultaneously shrugging off doomsday prophecies from financial experts, government regulations, and other challenges.

cryptocurrency into their economies. Estonia, for example, has even gone as far as proposing its own cryptocurrency, estcoin. Everyone from world leaders to, yes, average Joes and Janes ordering Friday night pizza, will have a role to play in the Bitcoin economy.

Haters Gonna Hate

Despite Bitcoin's meteoric rise in 2017, not all the titans of industry have welcomed it with open arms. Perhaps the most prominent recent example of a financial don issuing dire warnings

about Bitcoin is J.P. Morgan CEO Jamie Dimon. Speaking at CNBC's and Institutional Investor's Delivering Alpha conference, Dimon savaged Bitcoin, saying, "It's just not a real thing. Eventually, it will be closed." He also appeared to put his money where his mouth was by adding that if he learned J.P. Morgan traders were trading Bitcoin, they'd be "[fired] in a second. It's against our rules, and they are stupid."

Dimon isn't the only head honcho in the industry to issue a sharp rebuke to Bitcoin and cryptocurrencies in general. In an early

October interview with *The Economic Times*, Mastercard President and CEO Ajay Banga had harsh words for “digital currency,” citing what he believes is a fatal flaw in Bitcoin’s decentralized nature.

“If the government creates digital currency, we will find a way to be in the game,” he said. “We will provide rails for moving currency from customer to merchant. The government-mandated digital currencies are interesting. Non-government-mandated currency is junk.

“If I pay for a bottle of water in Bitcoin, one day it is two bottles for a Bitcoin, [and] the other day it is 9,000 bottles. This does not work. Any currency needs stability and transparency, otherwise you will get all the illegal activities in the world. Why was the ransom for the [Wannacry ransomware] collected in Bitcoin? Why has China cracked down on Bitcoin?”

Also in October, Swiss bank UBS chairman Axel Weber added his own doubts about Bitcoin’s efficacy, citing his previous experience as president of Deutsche Bundesbank, Germany’s central bank, as a major source of his reservations. At a Swiss Finance Institute conference, Weber said, “The important function of a currency is, it’s a means of payment, it has to be generally accepted, it has to be a store of value, and it’s a transaction currency. Bitcoin is only a transaction currency,” according to a Reuters report.

Despite these apocalyptic warnings about Bitcoin from several VIPs of the financial world, not everyone is convinced that Bitcoin is a disaster waiting to happen.

“Some of [these stories] are just Chicken Little warnings,” says Bobby Ong, co-founder of Coin Gecko (www.coingecko.com), a data platform providing cryptocurrency information such as price, trading volume, market capitalization, etc. “J.P. Morgan is one of the banks actively trading in Bitcoin.”

In this instance, it appeared that J.P. Morgan was caught red-handed in a Bitcoin poop and scoop. Days after Dimon issued his Bitcoin smackdown, vigilant Internet watchdogs spotted what they thought was J.P. Morgan buying



J.P. Morgan CEO Jamie Dimon caused quite a stir in September when he referred to Bitcoin as a “fraud” during the Delivering Alpha conference. “It’s just not a real thing,” he said. “Eventually, it will be closed.” (credit: Steve Jurvetson, Flickr)

up Bitcoin exchange traded notes, which derive value from Bitcoin’s price. However, it’s unlikely that Dimon fired any of his traders for this particular purchase, and not because of any kind of double-dealing from Dimon or J.P. Morgan. Rather, these trades were independent consumers using J.P. Morgan as a platform to buy the notes, instead of the bank grabbing Bitcoin wealth for itself.

Still, one doesn’t have to look far to find plenty of financial experts who are bullish on Bitcoin. For every exec who declares that cryptocurrencies will eventually leave buyers penniless, there’s a hedge fund manager proclaiming Bitcoin is on its way to \$10,000 or that its market cap will eventually surpass Apple’s. Historically, Bitcoin’s price has been relatively stable. Aside from 2017, the only significant price spike occurred at the end of 2013, suggesting that its price will eventually stabilize again.

Regulators Gonna Regulate

When Bitcoin was born in 2009, it wasn’t even a blip on governments’ radars.

Now, obviously, with Bitcoin’s collective value fluctuating around \$100 billion, many nations are meeting it head on, implementing policies and regulations to have some measure of control over the cryptocurrency. However, like the private sector, there is no consensus among governments about how precisely Bitcoin should be handled.

China, for example, recently cracked down on Bitcoin and other cryptocurrencies within its borders by taking a number of actions. In early September, China’s central bank, the People’s Bank of China, outlawed future initial coin offerings and indicated it would be keeping a close eye on any ICOs that emerged prior to the ban, raising the possibility that these ICOs could still run afoul of Chinese law. Then, on Sept. 15, after days of speculation, two of China’s largest Bitcoin exchanges announced that they would be ceasing operation. In separate statements, OKCoin (www.okcoin.cn) and Huobi (www.huobi.com) said that they would comply with their country’s regulations, effectively ending their role as exchanges for Chinese users.

Predictably, Bitcoin’s price plummeted after the news. The price tumbled slightly after China’s ban on new ICOs, closing \$300 lower on Monday, Sept. 4, according to CoinDesk (www.coindesk.com), but it really cratered after OKCoin’s and Huobi’s announcements. Bitcoin’s price sank to \$3,226, the lowest it’s been since the exchanges shut down. Since then, of course, Bitcoin’s price not only recovered but also soared to new highs, showing that while cryptocurrency prices are highly susceptible to government actions they can also be resilient over the long haul.

“Whenever a large country announces negative regulations against cryptocurrencies, prices will fall, Ong says. “[Chinese regulations] brought the price from a peak of \$5,000 to nearly \$3,000. However, today, the price is trading at \$5,600, and it has no impact on prices anymore.”

Russia is another world power that recently announced tighter controls

over Bitcoin and other cryptocurrencies. According to Russian news organization TASS, Russian Finance Minister Anton Siluanov said that his government would be taking an active role in regulating cryptocurrencies. Siluanov added that the decision came after Russian President Vladimir Putin met with key officials specifically about Bitcoin and altcoins.

"The president voiced the issues related to cryptocurrencies," Siluanov said, according to TASS. "This includes difficulties of compliance with anti-money laundering legislation and cases related to complications of identification. That is why we agreed that the state should control the process of cryptocurrency emission and its circulation."

During the Oct. 11 talk with reporters, Siluanov didn't offer concrete examples of how Putin or other Russian leaders planned to rein in Bitcoin, but he suggested that Russia would attempt to implement cryptocurrency controls through legislation.

According to Ong, though, regulations don't have to be a bad thing, especially if they can foster wider Bitcoin adoption. He cites Japan as a leader in progressive regulation. At the end of September, Japan issued licenses to 11 Bitcoin exchanges, making them "official." According to CoinGecko's exchange tracker, two Japanese exchanges are among the top 10 most active exchanges internationally according to trading volume, with Coincheck (coincheck.com) accounting for nearly a quarter of all Bitcoin trading worldwide.

"It is in the best interest of regulators to have insights into the key checkpoints of the bitcoin economy, namely bitcoin exchanges," Ong explains. "The way to do so is to follow Japan's [example]. By being progressive, the country can also tap into the growth of this booming industry."

Innovators Gonna Innovate

Many countries have taken or are taking steps to have more oversight and control over cryptocurrencies. Others have devoted resources to integrate Bitcoin and other digital currencies into

Rosewill Digs Into Cryptocurrency Mining

As Bitcoin mining has grown in popularity, we've seen a similar rise in purpose-built systems intended to maximize mining operations. As power users take their mining ambitions from a casual hobby to a full-fledged money-making enterprise, typical PC hardware won't cut it. Rosewill is among the many manufacturers meeting the needs of enthusiasts who are ready to take crypto mining to the next level.

"We see a potential in this trending market," says Jesus Penaloza, Rosewill marketing specialist, "and we feel we can provide valuable product options to consumers who are starting off for the very first time or individuals who have been here since the beginning."

Currently, Rosewill offers a handful of options to build a mining machine. There are a pair of rackmount cases, the RSV-L4000B (\$179.99) and RSV-L4000C (\$199.99), which let builders install a ridiculous number of graphics cards (six and eight, respectively) up to 13 inches long. Both models have a 4U form factor, measuring 7 x 16.8 x 25 inches (HxWxD). They're compatible with ATX motherboards and support one 2.5-/3.5-inch storage drive.

"The RSV-L4000B and RSV-L4000C are fully compatible with our server racks and rails we already carry," Penaloza says.

Serious miners regularly make use of PCIe riser cards for their rigs, and Rosewill has developed a riser card kit (\$9.99) capable of withstanding the punishment of 24-7 operation. According to Penaloza, the secret lies within Rosewill's power implementation. "While other vendors use onboard SATA power connectors, we've validated that 6-pin PCIe Express power connectors secure better amperage and voltage to reduce the risk of power fluctuations."



their everyday economies. We've already mentioned that Estonia is mulling the

creation of its own cryptocurrency, estcoins, which would of course make it

a state-sanctioned currency. Estcoins are interesting in their own right, but they have the potential to rise above the rabble of altcoins because of Estonia's pioneering effort to create a genuine, functioning digital society, e-Estonia (e-resident.gov.ee). A key benefit of becoming a citizen of e-Estonia is that you can establish a business without ever setting foot in Estonia itself. (Further, Estonia touts the always-on aspect of nearly every public service; only marriage, divorce, and real estate transactions require a physical presence in the country.)

As more people become e-residents, and as these people establish businesses, estcoins could easily become a popular method for transactions. A common criticism of cryptocurrencies, including Bitcoin, is that despite their value and continued presence there are still very few merchants, service providers, and other businesses that actually accept them as a method of payment. With estcoins, if Estonia does in fact implement its own cryptocurrency, that could quickly change

for e-Estonians. Regular use would grant a degree of legitimacy to Estcoins and cement them as a cryptocurrency that actually works as currency.

"They are pushing the boundary on what is acceptable to be done by a nation state in the crypto space," Ong says.

While Estonia considers an official ICO, other places are more than happy to accept your hard-mined Bitcoins. In fact, if you need to lighten your Bitcoin wallet, one of the best places on the planet to do so is Bitcoin City, located in Arnhem, Netherlands. Or, you can mash up these names to arrive at what the locals like to call it: "Arnhem Bitcoinstad" (www.arnhembitcoinstad.nl).

Billed as the "world's most Bitcoin-friendly city," Arnhem has been steadily increasing the number of businesses that accept Bitcoin since 2014, when a trio of Bitcoin evangelists set out to convince local merchants to take the cryptocurrency. On May 28, 2014, Bitcoin City consisted of 15 Arnhem businesses that let their customers pay

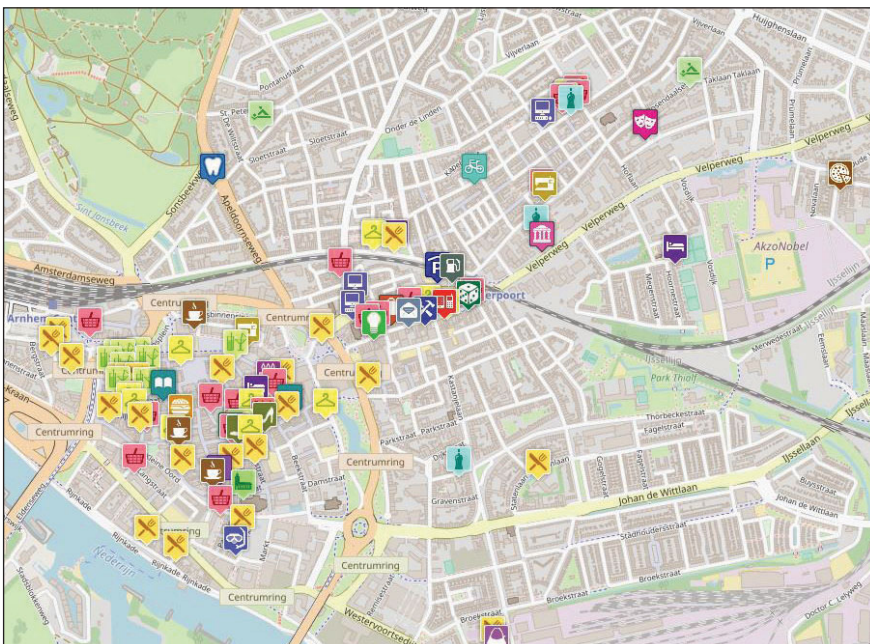
using Bitcoin. Since then that number has grown to over 100. Although most of these businesses are restaurants and bars, there is nonetheless an impressive array of services you can purchase with Bitcoin. A handful of hotels will let you book a room and pay with Bitcoin. You could get a massage or a new hairstyle, visit a museum (the Dutch Wine Museum, to be specific), catch a musical at Theater de Leeuw, or have Jeroen Oostbanden rotate your vehicle's tires. Further, the BitKassa (www.bitkassa.nl) payment system lets patrons settle their tabs with a smartphone, tablet, or computer, and businesses that use BitKassa don't have to pay transaction fees that are associated with traditional debit or credit cards.

"Sister" Bitcoin Cities have sprung up in Belgium, the Netherlands' neighbor to south. Ypres and Ghent both have a coalition of businesses set up for easy Bitcoin payment. However, these two cities have yet to draw the same level of participation as Arnhem. Ghent has just over two dozen places to pay with Bitcoin, and the number of Bitcoin-friendly merchants in Ypres totals 14. These numbers, even in Arnhem, probably don't yet represent a tipping point toward widespread Bitcoin adoption, but being able to buy new threads or pick up your friends' bar tab with Bitcoin is a step in the right direction.

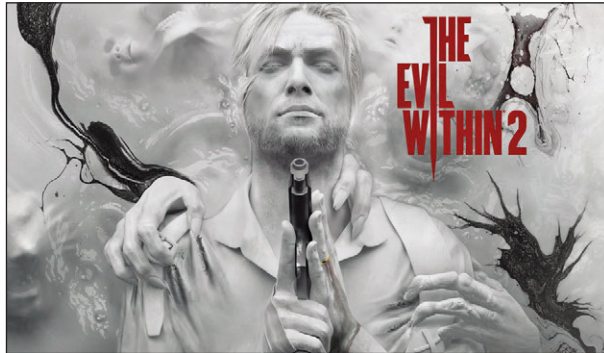
The Future According To Bitcoin

Genius investment or bubble waiting to burst, the future of payments and transactions or a pipe dream of blockchain evangelists—Bitcoin rarely prompts a lukewarm reaction. Regardless of each individual's opinion, it feels like the next big Bitcoin story is right around the corner.

Bitcoin might not directly find its way into your wallet in the next year or in the next five years, but that doesn't mean you won't cross paths with it. "I think in the future, cryptocurrencies will be used a lot as a building block sitting behind the scenes for many apps," Ong says. "We may be using crypto without even realizing it in the future in our favorite apps." ■



As much of the world still tries to make sense of Bitcoin and its place in local and global economies, some places are embracing it. In Arnhem, Netherlands, dozens of businesses are set up to accept Bitcoin payments, and not just for a cup of coffee or a bite to eat. Businesses ranging from hair stylists to dentists will also let you use Bitcoin for their respective services.



The Evil Within 2 is a survival horror game that'll call to mind just about every previous survival horror game you've ever played. This game has scares aplenty, but they're tempered by an ever-growing arsenal of weapons and ability upgrades that'll let you unload all that pent-up adrenaline in spectacular fashion. You play as Sebastian Castellanos, who has once again agreed to jack into STEM, a Matrix-like virtual world where the consciousnesses of a whole town's worth of people are united in an attempt to create a utopia of happy feels. Unsurprisingly, the idyllic town of Union inside STEM begins to literally tear itself to pieces and its suddenly mutated inhabitants turn violent.

Mobius, the shadowy organization behind STEM, is using Sebastian's kidnapped daughter Lily as the Core in an effort to keep the system online and intact. The beleaguered detective had long thought that Lily died, trapped in their home as it went up in flames years ago, but his former partner—an undercover Mobius operative—reveals early on that the girl's kidnapping was a conspiracy. Mobius, whose multitudinous tentacles are suctioned onto every level of society and government, has enlisted a reluctant and disbelieving Sebastian to track Lily down. It's her virtual disappearance somewhere within Union that's being blamed for the upheaval.

The Evil Within 2 sketches out pretty effectively what occurred at Beacon Hospital during the events of the first game. What The Evil Within 2 doesn't do very effectively is create a believable plot. For a majority of the game, Sebastian is tasked with tracking down the serial killer who has taken Lily and seized control of Union. But once Sebastian identifies the psycho, Mobius doesn't just saunter over to



Something Is Rotten In Union

BY ANDREW LEIBMAN

\$59.99 (PC, PS4, Xbox One) • ESRB: (M)ature • Tango Gameworks
theevilwithin2.bethesda.net

his pod and unplug him—a feat which we're told would instantly kill anyone not properly disconnected. When the antagonist shifts in the latter third of the game, Mobius again doesn't pull the plug.

The game leaves other seemingly important things unexplained, like Tatiana, the cryptic lady who upgrades Sebastian's abilities in exchange for green liquid picked up from fallen creatures. The mutating Union residents are eventually explained with the narrative equivalent of a shrug. You also can't help but wonder about Mobius, an organization that doesn't bat an eye at kidnapping children, experimenting on unwitting and unwilling subjects, and sacrificing its own employees, but we're supposed to accept that its primary motivation is to create a happy place for all of humanity? Hot stock tip: evil corporations sending mixed signals are not a good buy.

All told, the game took us about 20 hours to complete, but we scavenged every nook and cranny for the Bethesda-themed hidden objects, and replayed a few encounters looking for ways to minimize our ammo consumption. Managing resources is a must for this game.

At the center of the experience is Sebastian Castellanos, who feels like a genuine person trying to do right by his family. Weird stuff is happening, mostly for the sake of weirdness, but you'll find yourself driven to help him find his daughter, get his wife back, and amid the chaos of a world that is splitting at the seams, hold onto the things that really matter.

If a mashup of The Last Of Us, F.E.A.R., the latter-day Resident Evil games, Layers Of Fear, and Silent Hill sounds enticing, then you should check out The Evil Within 2. Just don't bother about logic and coherency, because the narrative certainly doesn't. ■



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From Small Fry To Burgher King

BY VINCE COGLEY

\$29.99 (PC) • ESRB: (R)ating Pending • THQ Nordic
theguildgame.com

A close cousin to city builders, “Tycoon” games (or business simulators, for the boring at heart) have existed nearly as long as PC games themselves. They found their first opportunity in the spotlight in 1983 with M.U.L.E. and really exploded when Sid Meier’s first Railroad Tycoon debuted in 1990. Since then, there’s been a steady stream of games that let you build a global mega corporation from scratch.

The Guild 3 dials the clock back to the Middle Ages and gives you the chance to start as a pauper and become a titan of industry using your own two hands (or the hands of the laborers you’ll eventually employ). The work of Canadian developer GolemLabs, The Guild 3 is the latest installment of a franchise that hasn’t seen a meaningful new game since 2010.

The game was released on Steam at the end of September as an Early Access title, and we must stress the lattermost aspect most of all. Unlike a lot of Early Access games, which are virtually finished products when they become available, The Guild 3 takes full advantage of its Early Access status. Since its launch, it’s been plagued with a swarm of game-breaking bugs—which, to GolemLabs’ credit, are being patched on a regular, sometimes daily, basis—that have led GolemLabs to update its roadmap; a series of three additional content patches are scheduled for the remainder of the year, and several more features are being planned for 2018. Long story short, The Guild



3 still has a long road ahead of itself before a final release is ready to go. Guild supporters, buckle up, because you’ll need to be in for the long haul.

However, The Guild 3 already shows plenty of promise. When I played, you can choose from three cities to set up shop, as it were, and more are being planned. What starts as a fairly straightforward plan of “buy raw materials on the cheap, then turn them into finished goods to sell back at a higher price” eventually expands to take you in a few different directions. For example, once you’ve amassed enough cash, you can hire workers to handle your character’s day-to-day operations while you devote attention to political intrigue, securing a marriage, and other tasks to establish and preserve your family dynasty.

Of course, The Guild 3’s bread and butter is its crafting system, which is pretty good. You can sink a lot of hours into simply making (and selling) bigger and better items, and the game’s skill tree lets you unlock even more. Fans of previous Guild games (in the interest of full disclosure, we haven’t played any of them) will likely be in love.

Aside from the bugs, we did struggle with The Guild 3’s camera, which felt like a minigame—and not a fun one—in and of itself. The Guild 3 prides itself on its scope and size; its wonky camera really hamstrung that experience. Otherwise, understand that your 30 bucks is helping fund a game that could be (but isn’t yet), superb once it’s polished. ■





Every year, a few games come along and, if they don't totally redefine their respective genres, deliver memorable adventures, mind-blowing action, and possibly multiple playthroughs. This year has given us blockbusters like *Destiny 2*, *The Legend of Zelda: Breath of the Wild*, *Horizon: Zero Dawn*, etc. *ELEX* (like "helix" but without the "H") tries to be one, too, by borrowing a little from every other blockbuster you've played in the last five years.

That's hyperbole, obviously, but it's also not too far from the truth. Check out the totally-not-Halo-you-guys logo for immediate proof. Hack, slash, and blast your way across *ELEX*'s fictional world Magalan (just "Earth" probably would've been fine, to be honest), and you'll encounter elements that remind you of a host of popular titles from recent memory. Beneath this particular tent are calls to everything from *Witcher III: Wild Hunt* to *Fallout 4*, plus sci-fi super soldiers from whichever futuristic space shooter you fancy.

And yet, as far as worldbuilding goes, *ELEX* rarely feels like it's hammering square pegs through round holes. The game kicks off by selecting "Cosmic Disaster" from the menu of tried-and-true post-apocalyptic catalysts. Namely, a comet smashes into Magalan and wipes out most of civilization. A buzzkill, to be sure, but the people that weren't wiped off the face of the planet discover that after the comet taketh away, it also giveth in the form Elex, a wonder substance that does everything. No, really—Elex powers the technologically advanced faction's advanced weaponry while giving the medieval faction access to magic. "The story is ludicrous," one might say after being presented with such facts, but within *ELEX* itself it mostly makes sense.

ELEX really begins when our hero Jax's jet crashes in the Magalan hinterland. To add assassination to injury, Jax's brother Kallax arrives with a couple of grunts and coolly attempts to finish him off. Naturally, you survive and in short order stumble across the first of *ELEX*'s factions, the Berserkers. This is your wizard-warrior group; they see technology and religion as societal evils and Elex as a poison that corrupts those who use it. (Berserkers use it, too, but only after

A Little From Column A - Z

BY VINCE COGLEY

\$49.99 (PC), \$59.99 (XOne, PS4) • ESRB: (M)ature • THQ Nordic
elexgame.com

they transmute it to Mana, which makes it OK. Just go with it.) Other factions include the Clerics (who wield Elex-powered weapons and religious fervor), Outlaws (a post-apocalyptic biker gang about one Thunderdome removed from "Mad Max"), and the Albs (superhumans that have conquered the side effects of Elex addiction and now seek to eradicate the rest of humanity; Jax himself is a former Alb, which doesn't exactly ingratiate you with the locals). Regardless of which faction you choose, *ELEX* makes you fight tooth and nail for survival.

ELEX really is an ambitious world, as is the game itself, the work of German developer Piranha Bytes. Not only is its sheer sprawl impressive but Magalan also has a very lived-in feel. Many of the characters have their own backstories and colorful personalities, so even though we encountered odd turns of phrase and stilted dialogue as frequently as the mutated beasts of the planet's wild kingdom, we're giving Piranha Bytes a passing grade on the *ELEX*-verse.

Underpinning *ELEX*'s story and characters is a fairly typical action RPG, complete with crafting, skill tree, XP, and so forth. But what stands out more than anything, for better or worse, is Piranha Bytes' combat system. The melee component has a particularly steep learning curve, for example. If you can't manage, much less master, *ELEX*'s system of combos, finishers, stamina, and evasion, prepare for a brutal slog and lots of death (your death, that is). Some gamers like combat like this, a puzzle that rewards those willing to put in the time to solve it. Others prefer their puzzle action to be limited to puzzle games.

Neither philosophy is inherently worse than the other in a vacuum, but the former will definitely find *ELEX*'s gameplay more satisfying than the latter. On the other hand, there's so much to do, including additional playthroughs, so as you invest in *ELEX*, that investment should eventually pay dividends. At \$50 for PC (and 60 bucks for consoles), THQ Nordic has *ELEX* positioned as a blue-chip stock. We wouldn't blame you for waiting for a price drop. ■





There are all types of games and all types of gamers, and everyone has their favorite games or type of games. Some people can restrict their passion for games to a particular genre, and I envy those people. Because aside from Dance Dance Revolution and walking simulators, I've been cursed with a taste in games that's way too eclectic. More to the point, I have at various times in my life spent many, many hours playing JRPGs, and although I'm more of an FPS guy these days thanks to Halo, Destiny 2, and anything that comes from the good folks at Arkane Studios, I still love the JRPG formula.

Walking around a world map, encountering monsters, fighting those monsters, and then heading into dungeons to fight still more monsters in turn-based combat is a thing that just never got old for me, to the extent that I once spent enough time in Final Fantasy VII to max all my characters' stats and get all of the materia in the game (yes, even Knights of the Round).

I say all of this so you'll understand why Battle Chasers: Nightwar has been such a blast for me. I wasn't even familiar with the Joe Madureira comic that is the game's precursor, and although you don't need to be to enjoy this game, it's helpful to understanding Nightwar's art style. Joe Mad has a style that incorporates elements of traditional Western comics with a heaping helping of Japanese manga influence, and this blend oozes from every pore of this game.

Nightwar is the story of a young girl named Gully who sets off on a journey to find her father who has mysteriously disappeared,



Digital Joy

BY CHRIS TRUMBLE

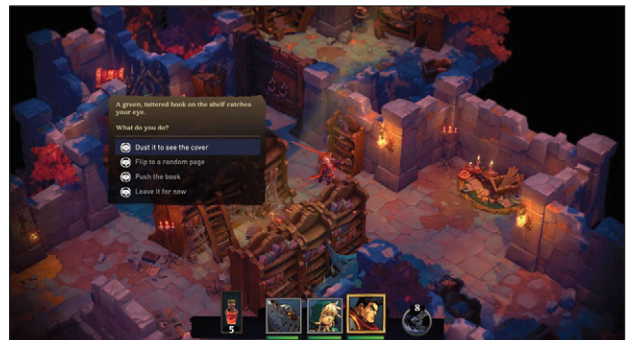
\$29.99 (PC, XOne, PS4) • ESRB: (T)een • THQ Nordic
www.battlechasers.com

leaving behind a powerful set of gauntlets with wondrous power. Bonus difficulty: evil forces want those gauntlets, and her journey is filled with peril. But Gully is not alone; a massive war golem named Calibretto, a wizard named Knolan, a seasoned swordsman named Garrison, and a bounty hunter named Monika all come along for the ride. They are joined in the game by a demon hunter named Alumon that wasn't in the comics.

Nightwar lets you control all of your party's spells and attacks in combat, and each has a signature ability you can use when traversing the many dungeons and "exploration areas" the game has to offer. And like any good RPG, it includes a strong element of equipment and item management, with some crafting thrown in for good measure. The enemies you defeat drop loot, you can buy things from shops, and you can make stuff, too. There's a lot of stuff, in other words.

The world of Battle Chasers is a cool fantasy setting with some steampunk folded in, and it's all rendered in the gorgeous, hand-drawn style from the Battle Chasers comics. If a steampunk fantasy game with a strong dose of manga sounds like a winner to you, you'll be happy to know that you can get this excellent game for just \$29.99.

Also, good news for Switch owners: Battle Chasers: Nightwar is headed your way at the end of the year, as well, although it looks like the Switch version will cost an additional 10 bones. Clear your calendar now. ■



Technically Speaking

Q&A With be quiet!

Technical Director Christian Rex

Q : So, be quiet! just launched its new SFX L Power PSUs; what makes them so well-suited to powering small form factor PCs?

CR : These PSUs provide up to 600W for a small system with 80 Plus Gold efficiency and full cable management, so they give users the highest possible flexibility for their system builds. And the SFX L can support high-end VGA cards without any problems and guarantee high stability.

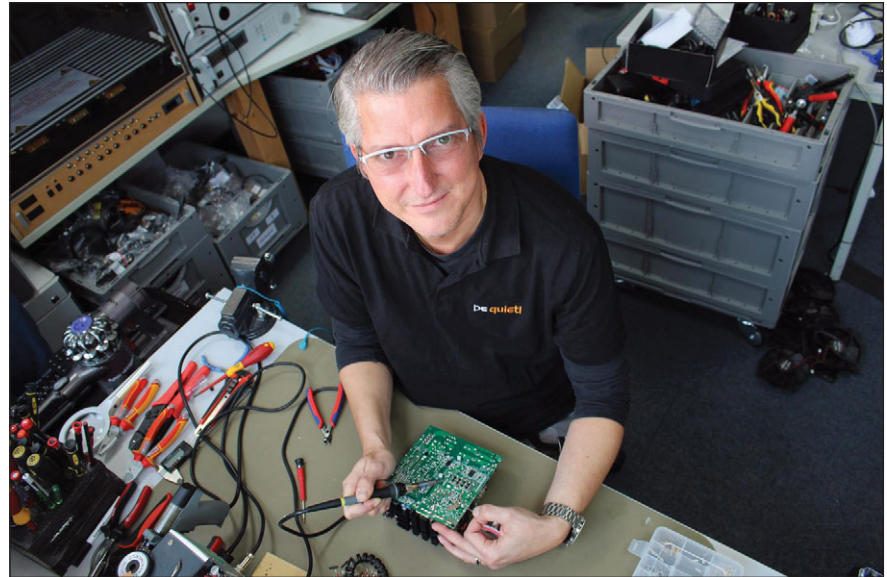
Q : The SFX L has an “LLC + SR + DC/DC” topography; what does that mean and how does it work?

CR : The LLC is a series resonant circuit using two coils (L) and one capacitor (C); this topology makes it possible to use FM (frequency modulation) inside the circuit to control the output characteristics instead of only using PWM (pulse-width modulation). So this LLC circuit uses FM and PWM as well as ZVS (zero-voltage switching) and ZCS (zero-current switching) to make sure the switching point inside the waveform for current and voltage will be always on the same point. This will avoid power loss and make the efficiency higher.

The SR (synchronized rectifier) will make sure that the output voltage from the transformer will be rectified under controlled conditions by an IC. The DC/DC will transfer the already rectified 12VDC voltage to 5V and 3.3V using active MOSFETs controlled by ICs to make sure the voltage will be always very close to the set point value.

Q : How does this topography differ from previous models and/or standard-sized power supplies?

CR : This topology is much more complex and offers higher efficiency,



better voltage regulation, and lower ripple/noise under all loading conditions.

Q : Why did your team decide to equip the SFX L with flat cables?

CR : In fact, this is a market demand and we follow the wishes of our customers. We do a lot of market research and talk to reviewers and forum people to understand what people like and what will be best choice on cable settings for each PSU series. We also always have an eye on our competition, and we try to follow market trends, as well.

Q : Are there challenges in designing an SFX power supply in general that don't exist in bigger form factors, and if so, what are they?

CR : The biggest challenge in developing a small form factor PSU always is the high density of components due to a lack of space. This can create challenges like EMI (electromagnetic interference) between

components, so it's sometimes difficult to find the correct balance between needed performance and EMI issues.

Q : Is it difficult to integrate a 120mm fan into an SFX power supply? Seems like these typically have 80mm fans, right?

CR : For Standard SFX with a case length of 100mm the only reasonable fan size is 80mm. Our SFX-L units have a case length of 130mm, which makes it possible to use a 120mm fan, but only with a height of 15mm. (A standard fan normally has a 25mm height.) SFX and SFX-L PSU enclosures only have a height of 63mm, and the space is already reduced by the fan, case material, and free space under the PCB, so it only left around 38mm space for the electronic components. So yes, it was kind of difficult and a challenge to squeeze all the necessary components inside.

Q : How much difference does the larger fan make in terms of the sound it produces at rest and under load?

CR : If I compare the same-wattage (400 watts, for example) SFX PSU with an 80mm fan (assuming 80 Plus Bronze efficiency) and an SFX-L PSU with 120mm fan (80 Plus Gold efficiency), the noise difference is approximately -10dB(A). This takes into account not only the fan size difference, but also the different efficiency level—lower efficiency creates more heat inside a PSU and will require higher airflow by the venting fan.

Q : Does the SFX L contain a Silent Wings 3 fan like some of your other PSU models, or something else?

CR : Because the fan inside the SFX L only has a height of 15mm, it is not a commonly used fan size. Rather than

emphasis for the development of all our PSU series besides fan selection and development.

Inside, a PSU can have many different noise sources under different load conditions, different ambient conditions, or even by using a different AC input voltage and frequency. We normally differentiate among the following kind of noises: wind/air noise, electronic noise, mechanical noise, acoustic noise, and magnetic noise.

For each segment, we use different kinds of testing methods, like measuring the real noise in an acoustic chamber with less than 7dB of background noise to get the real noise in dB(A) for each load or set of conditions. Or we test the whole frequency spectrum humans can hear (0 to 20KHz) with an analyzer to



be quiet!'s new SFX L Power 600 power supply unit.

developing a new Silent Wings 3 fan for the SFX L line, we chose to use another fan and modify it to meet our demands for the unit.

Q : We tend to think primarily of the fan when considering power supply noise, but do other components contribute to ambient sound levels as well, and if so, what are they?

CR : This is a good question, and the answer could probably fill an entire book! This is also one of my major points of

see in what frequency we may have a noise issue.

The reasons for noise also can be very different. For example, a PSU may get feedback noise from a high-end VGA card, so we will reduce this feedback noise by adding capacitors (maybe electrolyte or solid caps, it depends on the frequency and location). Furthermore, the noise also may come from PFC (power factor correction) circuit, so we will change the PFC cap and PFC coil as often as needed to get the noise level in an acceptable range.

Q : What types of usage scenarios did you have in mind when designing the SFX L power supply?

CR : We developed the SFX L for users who would like to build small form factor systems for gaming with a focus on low acoustic noise emissions. This is why we included two PCIe 6+2-pin connectors on our PSU.

Q : As you mentioned earlier, the SFX L Power PSUs have 80 Plus Gold certification, whereas the older SFX Power 2 units have 80 Plus Bronze efficiency. Is this due to newer technology, or does the higher efficiency have something to do with the SFX L's larger chassis? (Or some other reason altogether?)

CR : There are different reasons; the main focus is always to create a PSU with low noise, so it was the logical choice to use the LLC topography, because it let us build in gold-level efficiency. On the other hand, our SFX is already a little older, so at that time it was the right choice to use that topology with bronze-level efficiency to get the correct price points on the market.

Q : You launched the SFX L line with 500- and 600-watt models, and that makes a lot of sense given the system type you mentioned above, but could you coax more power out of a PSU this size if you needed to, and are there any plans to provide higher-wattage SFX L units?

CR : We know our competition also have SFX-L units with over 600W and we considered that, but if you look at the price/performance ratio of these units, it's easy to see that they don't compare very well to standard ATX power supplies. And if a system demands more than 600 watts (which probably means CrossFire or SLI plus a high-end CPU), the cooling capabilities of a small form factor case might not work perfectly for them, so they'd need an ATX case. If so, an ATX power supply will fit nicely and will run more quietly, too. ■

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11.03-04.17

Legendary LAN 2017
Harrisburgh, PA

legendarylan.com/tournament/event-legendary-lan-2017

11.03-06.17

PDXLAN NOV 2017
Portland, OR

www.lanreg.org/pdxlan/pdxnov2017

11.04-05.17

BoilerFrag
West Lafayette, IN
pugg.org

11.10-12.17

LANFest InfernaLAN Fall 2017
Puyallup, WA

lanfest.intel.com/events/infernaln2017

11.10-12.17

Ready To Fight: Fall Damage
Laughlintown, PA
<http://readytofight.me>

11.11-12.17

Catacombz 26
El Dorado, IL
www.catacombz.com

11.17.17

Afterlife LAN Thanksgiving Event
Springdale, AR
fslan.com

11.17-19.17

Battle Of The LAN
London, Ontario
techalley.ca

11.17-19.17

November LAN
Menomonie, WI
pong.uwstout.edu

11.17-19.17

San Diego Winter LAN-A-THON
San Diego, CA
www.SanDiegoLAN.net/LANaThon.html

11.18.17

Critgamer LAN
Tyler, TX
www.critgamer.com

11.18.17

Oklahoma Gamers Group
Oklahoma City, OK
www.OKGG.org

11.18.17

Source Gaming Lounge
Denton, TX
sourcegaming.org

11.18-19.17

Windy City LAN 3.0
Chicago, IL
www.windycitylan.com

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2017 Winter LAN
Rochester, NY
www.egsrit.com

1.6-7.18

NAG LAN Party
Medina, OH
www.nagitech.net/nag-lan-party

11.24-26.17

LANTastic VIII
Waterloo, Ontario
lantastic.ca

1.12-14.18

PAX South
San Antonio, TX
south.paxsite.com

11.25-26.17

Wichita LAN 34
Lyons, KS
www.facebook.com/events/327652644327719

1.19-20.18

Forge LAN 11
Medina, OH
<https://www.lanreg.org/forgelan/forgelan11>

12.01-03.17

KCGameOn 78
Kansas City, MO
kcgameon.com

2.17-18.18

Playthrough Gaming Convention
Raleigh, NC
<https://www.playthroughgc.com>

12.01-03.17

LANFest Great Escape LAN - VII
Sacramento, CA
<https://lanfest.intel.com/events/great-escape-vii/main>

2.22-25.18

PDXLAN 31
Portland, OR
<https://www.lanreg.org/pdxlan/pdx31>

12.16.17

Dirty Santa Comes To The LAN
Oklahoma City, OK
www.OKGG.org

3.15-17.18

SXSW Gaming
Austin, TX
<https://gaming.sxsw.com>

12.16.17

Source Gaming Lounge
Denton, TX
sourcegaming.org

4.5-8.18

PAX East
Boston, MA
<http://eastpaxsite.com>

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Q&A With James Prior

AMD's Senior Client Product Manager Talks Threadripper

We reviewed AMD's flagship Ryzen Threadripper 1950X in our October issue, and came away suitably impressed. But as power users know, there's more to evaluating a processor than comparing benchmark scores, so we talked to AMD Senior Client Product Manager James Prior for more information.

Q: Now that Threadripper is in the wild, does it accomplish all you set out to do when designing it?

JP: Absolutely! With Ryzen Threadripper, we delivered a truly HEDT-class platform that continued the disruption begun with our Ryzen processors, whilst allowing AMD to offer unmatched features and performance at the price points. It's an incredible feeling to be celebrated by users and media alike for the absolute performance on offer, backed up by leadership I/O and memory bandwidth.

Q: How is Threadripper's architecture different from the initial Ryzen chips?

JP: Ryzen processors mark a complete departure from previous-generation processors. We created a single die based on the new "Zen" x86 architecture, offering eight cores with simultaneous multi-threading and dual-channel memory in the AM4 platform.

To develop Ryzen Threadripper we leveraged AMD's extensive expertise in multi-chip module packaging from the server side of the house, and took the top 5% of Ryzen dies as Threadripper processor candidates.

Each Ryzen Threadripper processor includes two Ryzen dies, enabling the SocketTR4 platform to offer up to 16 cores and 32 threads, quad-channel memory, and 64 PCIe lanes. As part of the journey to create the product,



AMD looked for ways to offer more for buyers, as compared to the Socket AM4 Ryzen desktop processor. Some key differentiation points were increasing the Precision Boost and XFR frequencies, and doubling the number of threads operating at those frequencies.

Q: What exactly is Infinity Fabric, and how does it improve on HyperTransport?

JP: Infinity Fabric is AMD's new data fabric for SoC designs. The Infinity Fabric is designed to enable lightning-fast data transfers that take advantage of all the latest technology we implement in the product. Compared to

HyperTransport, the Infinity Fabric has four main benefits:

- Increased performance and power efficiency: HT3.0 was clocked at 3200MHz with 16-bit bidirectional capabilities for 25.6GTps bandwidth; Ryzen Infinity Fabric is clocked at the same speed as the base memory clock and is 32-bit bidirectional, for a minimum speed of 28.8GTps (DDR4-1866) and a maximum speed of 42.6GTps. The last processors to feature HyperTransport were the FX series, so they were built on 32nm SOI process and had a voltage of 1.2V, whereas Infinity Fabric is featured in Ryzen and built on 14nm LPP and has a voltage of 0.7 to .0.8V. Lower voltage equals less power; higher bandwidth equals faster; faster at lower power equals better efficiency.
- Scalable bandwidth, low latency, and QoS (Quality of Service) capabilities.
- Flexible, coherent interfaces across multiple types of cores.
- Robust security and authentication.

The Infinity Fabric controller implements SenseMI, which has overarching control of the entire processor and "senses" that detect various physical properties across the multiple domains in the processor. With older implementations before Ryzen, we provided a custom method to track overall power usage by simply looking at the overall power usage of each individual engine. We would set

voltages and frequencies for the engines based on overall guard bands. With SenseMI, each chip now has the ability to intelligently look across temperature, utilization, etc. to regulate power and frequency effortlessly.

This information, frequency and voltage, is tuned for the optimal power consumption at the performance being delivered. With Infinity Fabric, we have a repeatable, highly tuned, and intelligent approach to extract the best out of the products we design.

Q: The Threadripper package and SocketTR4 socket are pretty big; why is this size necessary, and does it present any design challenges that the first wave of Ryzen chips did not?

JP: To enable the fastest time to market, AMD decided to forgo developing a specific package and socket for Ryzen Threadripper. By leveraging the packaging developed for AMD EPYC server processors, we dramatically shortened platform development cycles, as our technology partners were able to

non-functional in every respect and are basically rocks, so that when coolers are installed the integrated heat spreader lid does not collapse.

Part of our pre-launch validation was to work with liquid-cooler and air-cooler manufacturers to see what kind of compatibility with in-market products was possible. Thanks to our great relationships with those companies, we were able to develop an adapter bracket (included with the Threadripper processor) for Asetek-based all-in-one liquid-cooling systems for broad day one aftermarket cooler compatibility.

Q: Threadripper includes more PCIe lanes than any CPU to date, which is great; our readers love to have a lot of options when building their systems. Is it difficult to design such extensive PCIe support into a CPU?

JP: With the server heritage AMD has, the complexities of a high number of PCIe lanes are well known by our engineering team and motherboard partners. So while there's an increased level of complexity to designs, there's also extensive experience in our ecosystem. The bigger challenges are thinking through the right number of lanes for the market segment being targeted and what kind of devices are being supported.

Q: What's the highest stable overclock you're aware of so far on the 1950X?

JP: Assuming "stable overclock" means using conventional cooling vs. extreme cooling methods like liquid nitrogen, then I would say 4.2GHz to 4.3GHz on all cores and threads, with a custom liquid-cooling loop is the best I've seen so far.

While AMD has found that a full coverage head or heatsink base is not required for standard operation, for high

overclocks I think it is best to design a setup that has great airflow on the VRMs, that the heatsink head is sized to take full advantage of the integrated heat spreader thermal transfer capabilities, and that the radiator is sized—and paired with appropriate fans—for optimal heat dissipation.

Q: What is the ideal usage case for Threadripper?

JP: The AMD Ryzen Threadripper was designed for the ultimate HEDT platform, designed for consumers and prosumers alike who need a lot of processing power combined with massive I/O capabilities. Content creators, data scientists, 3D renderers, video editors, and consumers who megatask and want to do more at once with little to no slowdown for their computing needs. We've seen a lot of excitement amongst users of applications like KeyShot, Adobe CC, Blackmagic, HandBrake, Open Broadcaster Software, xSplit, and software compilers, too.

Q: Now that you've mastered 16 cores and 32 threads, what's next for Ryzen and Threadripper?

JP: Recently, AMD released a free update for Ryzen Threadripper and the X399 platform that enables RAID support for NVMe devices, including bootable RAID 0/1/10 with hot spare capability. We plan to continue to develop the performance and features of product, firmware, and software to help ensure the best possible experience for Ryzen Threadripper users.

The immediate road is to develop the ecosystem and firmly establish the processor in its rightful place as one of the best HEDT processor choices. For future product updates, we are working on leveraging the upcoming technology advances we have planned for our compute roadmap as well as gathering user feedback on what improvements are expected—and needed—for Ryzen Threadripper. ■



leverage the massive resources in flight for bringing EPYC to market.

Ryzen Threadripper also required a new substrate for the two active dies to enable the specific performance and product characteristics we desired. To maintain package mechanical integrity, we included two dummy dies that are



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